SCIENCE

EDITORIAL COMMITTEE: S. NEWCOMB, Mathematics; R. S. WOODWARD, Mechanics; E. C. PICKERING, Astronomy; T. C. MENDENHALL, Physics; R. H. THURSTON, Engineering; IRA REMSEN, Chemistry; J. LE CONTE, Geology; W. M. DAVIS, Physiography; HENRY F. OSBORN, Paleontology; W. K. BROOKS, C. HART MERRIAM, Zoology; S. H. SCUDDER, Entomology; C. E. BESSEY, N. L. BRITTON, Botany; C. S. MINOT, Embryology, Histology; H. P. BOWDITCH, Physiology; J. S. BILLINGS, Hygiene; J. MCKEEN CATTELL, Psychology; J. W. POWELL, Anthropology.

FRIDAY, APRIL 20, 1900.

CONTENTS:

The Atomic Theory from the Chemical Standpoint: DR. H. N. STOKES 601
Some Objections to the Atomic Theory: DR. FRANK K. CAMERON 608
On Artificial Parthenogenesis in Sea Urchins: PROFESSOR JACQUES LOEB 612
A Curious Phase of Inter-stream Erosion in Southern Oregon: OSCAR H. HERSHEY 614
The Sixty seventh Annual Report of the Coast and Geodetic Survey: E. D. P 616
Scientific Books:—
The Decennial Celebration of Clarke University: C. S. PEIRCE. *Ellis's Analysis of the White Paints:* PROFESSOR JAS. LEWIS HOWE. *Davis on the Refraction of the Eye:* C. A. O 620
Scientific Journals and Articles 623
Societies and Academies:—
New York Academy of Sciences, Section of Astronomy and Physics: DR. WILLIAM S. DAY. *Section of Geology and Mineralogy:* DR. THEODORE G. WHITE 624
Discussion and Correspondence:—
The Plumages and Moults of the Indigo Bunting (Passerina cyanea): DR. JONATHAN DWIGHT, JR. *Indian Pictographs on the Dakota Sandstone:* CHARLES NEWTON GOULD. *Systematic Arrangement of Ore Deposits on a Geological Basis:* DR. CHARLES R. KEYES 627
Notes on Inorganic Chemistry: J. L. H 632
Tobacco, Tobacco-pipes and Smoking: A. S. G 633
Scientific Notes and News 634
University and Educational News 639

MSS. intended for publication and books, etc., intended for review should be sent to the responsible editor, Professor, J. McKeen Cattell, Garrison-on-Hudson, N. Y.

*THE ATOMIC THEORY FROM THE CHEMICAL STANDPOINT.**

THE Atomic Theory is the most fundamental hypothesis of the chemistry of to-day and plays a greater part in this than in any other science, and to give an account of all the classes of chemical phenomena which it is sought to explain by its aid would require far more time than I have at my disposal. I shall limit myself to giving as briefly as possible the main facts which have led chemists to adopt it and to stating which of the various properties which have been ascribed to the atoms are, and which are not, essential to its use in chemistry, and what properties may be attributed to them, solely on the basis of chemical experiments.

The question whether any given portion of matter is continuous, absolutely the same throughout, even if infinitely divided, or whether it consists of particles separated by comparatively empty space, is, of course, almost as old as philosophic thought. The beginnings of chemistry lie still further back; the first man who questioned why wood burns, or why grape juice turns to wine, was an incipient chemist.

About the middle of the seventeenth century, Robert Boyle, who originated our present conception of element and compound, applied the atomic theory to chemistry, in-

* Read before a joint meeting of the Chemical and Philosophical Societies of Washington, November 25, 1899.

terpreting chemical combination as a joining together of elementary corpuscles. Boyle's view had little influence on chemistry, and I think naturally. In the absence of more definite chemical knowledge than then existed, I should consider the conception that water and alcohol, for example, are perfectly continuous, and that their mixing is a perfect blending, quite as plausible as, and less contradictory to the evidence of the senses, than the view that they consist of discrete particles which mix, but do not penetrate each other. Up to the beginning of the present century those who adopted the atomic hypothesis did so from supposed physical or metaphysical necessity, rather than on the basis of any satisfactory chemical evidence.

The general acceptance of the atomic hypothesis by chemists was due to the experimental establishment of two laws, which are among the most fundamental principles of chemistry—the *Law of Constant or Definite Proportions*, and the *Law of Multiple Proportions*. For the benefit of those who have forgotten their chemistry I may state briefly in what these laws consist.

The Law of Constant Proportions.—Every chemical compound has an invariable composition, that is, the relative weights of the elements entering into it are invariable. On comparing the composition of numerous substances, it was soon found that to each element might be attributed a certain number, the *combining number*, which represents the proportion by weight in which that element enters into combination. If we compare, for instance, the compounds which the akali metals lithium, sodium and potassium form with the halogens chlorine, bromine and iodine, we find the following relations: 7 parts lithium unite with 35.4 parts chlorine; 80 parts bromine, or 127 parts iodine; similarly 23 parts sodium unite with 35.4 parts chlorine; 80 parts bromine, or 127 parts iodine, and so on.

Lithium.	Sodium.	Potassium.
7.	23.	39.
Chlorine.	Bromine.	Iodine.
35.4.	80.	127.

These figures, which merely express the results of analysis, are the combining numbers, and to each of the seventy-five or more elements belongs its own proper combining number.

The Law of Multiple Proportions.—Elements often combine in more than one proportion. When this is the case, the different weights of the one, which unite with a given weight of the other, bear a simple relation to each other. A good example of this is found in the chlorides of the metal molybdenum, of which four are known. The combining number of molybdenum is 96, and 96 grams molybdenum combine with respectively 2, 3, 4 and 5 times 35.4 grams chlorine, 35.4 being the combining number of the latter, the resulting compounds being represented by the formulas $MoCl_2$, $MoCl_3$, $MoCl_4$ and $MoCl_5$. A somewhat more complicated case is found in the paraffine series of hydrocarbons, CH_4, C_2H_6, C_3H_8, C_4H_{10}, C_5H_{12}, etc. Both laws apply as well when the compounds contain more than two elements.

These two laws hold without exception through the many thousands of known chemical compounds. They involve nothing hypothetical, being simply the expression of analytical results in a particular form. They were established mainly through the labors of Richter, Proust, Dalton and Berzelius, but to Dalton belongs the credit of having employed the atomic theory in explaining them.

If matter be absolutely continuous and capable of any degreee of subdivision, it is difficult to see why each element should have a definite combining number, which holds without exception, and why there should be distinct compounds well marked off from others, instead of different sub-

stances shading off into each other by infinitesimal differences. Why, for example, should there not exist a sodium chloride with 34 or 36 parts chlorine to 23 parts sodium, as well with 35.4 parts? It is true that we may bring these elements together in any proportion, but unless the ratio is just 23 to 35.4, the excess of the one or the other will be left unchanged, and we always obtain a chloride with 23 parts sodium and 35.4 parts chlorine. The hypothesis of continuity does not explain why, in the series of molybdenum chlorides just mentioned, the weights of chlorine combining with a given weight of molybdenum should be in the proportion 2, 3, 4, 5, without any or every intermediate figure. It is quite as difficult to explain on this view why the same combining number always adheres to the same element no matter into what combine it enters; the combining number of chlorine might be 35.4 with respect to sodium, and any other figure with regard to lithium or potassium.

If, however, we assume that a given portion of each of the elements, instead of being capable of any degree of subdivision whatever, consists of minute parts, or atoms, each of which, while it may or may not be further divisible, nevertheless always acts in chemical reactions as if it were not, that is, acts as a whole; and if we assume that in the same elementary substance, these particles have the same weight, but that the weight differs in the case of each element, then we have a state of affairs which would necessarily lead to the two laws I have described. The combining numbers would represent simply the relative weights of these chemically ultimate particles; a sodium atom weighing 23, would unite with a chlorine atom weighing 35.4, or a bromine atom weighing 80, while a bromine atom weighing 80, would combine with one of potassium weighing 39. So, also, an atom of molybdenum, weighing 96, would unite with 2, 3, 4 or 5 chlorine atoms, each weighing 35.4.

It will be observed that this hypothesis involves no assumption as to the cause or manner of the union of these chemical atoms. Whether they simply lie side by side, each retaining its individuality, or whether they interpenetrate, fuse or blend together, and for the time lose their individual existence. We shall see presently that there are reasons for adopting the former view.

The *atom*, in a chemical sense, may be defined as the smallest portion of an element which acts as an independent unit in chemical changes; the chemical *molecule* is the smallest portion of any substance, elementary or compound, which retains all the chemical properties of the substance in mass and which can move to an unlimited extent, independently of other portions. The molecules of compounds, therefore, consist of several atoms; the molecules of elements, there is good reason to believe, are frequently composed of several like atoms, while in other cases they consist of but one. Each kind of atom, therefore, has a specific mass, represented by the combining number, and specific chemical qualities, by virtue of which the elements differ, as iron and sulphur. Of the relation of these little is known, except that the chemical qualities are to some extent periodic functions of the mass. It cannot be asserted that every atom has combining power, for a whole group of elements, the helium-argon group, shows no well-established tendency to form compounds.

Before proceeding to discuss the further properties which chemists have been led to attribute to the atoms, we may consider certain qualities which have from time to time been ascribed to them, but on which chemistry is silent. Speculators have often erred in attempting to elaborate their hypotheses too fully, and by making as-

sumptions which have afterwards proved to be improbable or untenable, have brought discredit on views, which in their essentials, were of great value. Perhaps no hypothesis has suffered more in this respect than the atomic theory. In his book on the 'Concepts of Modern Physics' (p. 85), Stallo mentions certain points on which, he says, all atomists are agreed. Among others are these: "*Atoms are absolutely simple, unchangeable, indestructible; they are physically, if not mathematically, indivisible.*"

Without speaking for the physicists, I can assert most positively that none of these attributes are in the least essential to the conception of the chemical atom. Whether the atoms be *simple* or *complex*, *divisible* or *indivisible*, we have at present no satisfactory means of deciding, and whether they be one or the other, it in no wise affects the conception of the atom as the chemical unit. It is believed by some, on spectroscopic evidence, that atoms are decomposed at the high temperatures existing in certain stars, and a similar explanation has been offered for certain electrical phenomena exhibited by gases. All we can say at present is, that by no chemical or physical process known to us, do atoms undergo division or transformation to an extent appreciable by chemical methods. An atom of carbon always acts with the combining weight 12; if it consist of several independent parts, we do not know it, because in all reactions thus far known, these parts always act together. The idea of the transmutation of the elements, while resting at present on a very slender basis, is entirely justifiable as a working hypothesis.

The supposed *indestructibility* of the atom amounts merely to this, that with our limited range of experimental methods, we have not been able to cause any appreciable portion of matter to disappear as such permanently, but can always recover it unchanged in mass and chemical properties. To assert that matter cannot, under any circumstances, be made to disappear as matter, seems to me to be the most unjustifiable dogma imaginable.

As to the *unchangeableness* of the atoms, we are equally in the dark. That an atom of oxygen in water is similar in every respect to one in iron rust, we cannot assert. There are certain physical properties of the elements which persist in their compounds, among which are the optical properties. Every transparent compound has a definite molecular refractive power, and it has been found that the figure representing this may be divided up in such a way as to assign a definite portion to each atom in the molecule. If we once know the atomic refractive powers of the several elements, we can calculate with considerable accuracy the molecular refraction of any compound containing these elements. For example, the molecular refraction of alcohol, C_2H_6O, is the sum of twice the atomic refraction of carbon, six times that of hydrogen and once that of oxygen. Now remarkably there are certain exceptions. For instance, oxygen combines in either of two ways, which are called single and double union, which are symbolically represented in the case of carbon compounds, by $C=O$ and $C-O$. Its atomic refraction is different in these two forms, and we cannot positively state that the difference is not due to a temporary change of some kind in the atom itself. At the same time (with the above qualifications and some others of a similar nature) the persistence of the atomic refraction and certain other physical properties through all the combinations of an atom, affords some indication that its nature remains essentially unchanged.

Finally, questions as to the shape, size, hardness or penetrability of the atoms, are matters of indifference to the chemist at present. For his purposes they may be regarded simply as centers through which

energy manifests itself, of like properties in the same element, but differing in mass and certain other respects in the different elements.

We may now consider some of the properties which the chemist does ascribe to the atom in addition to mass and specific chemical nature.

In recent years much has been learned about *chemical affinity*, a great part of which is susceptible of mathematical expression, and is independent of the atomic theory, only the experimentally determined combining numbers coming into consideration, the *gram atom* and *gram molecule* taking the place of the atom and molecule. As to the real cause or nature of affinity we are still totally in the dark. Very elaborate researches, however, have brought to light certain important facts to which I may properly refer, as they are at present incapable of interpretation apart from the hypothesis of atoms.

Each unit of an element is capable of uniting with but a limited number of other units, which differs in different cases. This may be illustrated by the hydrogen compounds

$$ClH,\quad OH_2,\quad NH_3,\quad CH_4.$$

The carbon atom can hold four hydrogen atoms, the nitrogen atom but three, the oxygen atom but two, and the chlorine atom but one. The combining power of carbon, nitrogen and oxygen atoms may be regarded as divisible into four, three and two parts respectively (with regard to hydrogen), while that of the chlorine atom is indivisible. The number of parts into which the combining power is thus divisible is termed the *valency* of the element, and each of these parts is termed a *valence*, *bond*, or *affinity unit*. Without going further into detail (for the subject is an elaborate one), it may be stated as a general law, that combination takes place by a valence of one atom acting on a valence of another atom, or by the several valences of one, acting on the corresponding number of valences of another atom or atoms. This is conveniently represented by lines joining the atomic symbols. Thus CH_4 and H_2O may be represented by the formulas

$$\begin{array}{c} H \\ | \\ H-C-H, \\ | \\ H \end{array} \quad \text{and} \quad H-O-H$$

as the oxygen atom has two valences, these may combine each with a valence of carbon, thus

$$O=C=O.$$

This law holds invariably in the case of carbon compounds, and in general, but whether combination takes place only in this way in all classes of compounds is as yet an open question. The number of valences has nothing to do with the strength of affinity; a pentavalent atom has not five times the affinity of a univalent atom.

It was long ago discovered that there could exist several substances of the same percentage composition and molecular weight, but differing in chemical and physical properties, the so-called *isomeric* compounds. Sometimes as many as twenty distinct compounds of the same composition are known. This difference is inconceivable if the atoms are indiscriminately arranged, like a lot of different colored balls thrown together at random; there must be in each a definite arrangement of the atoms which cannot be changed without changing the nature of the compound. A comprehensive study of compounds, aided by the conception of valency, has led to the idea of the linkage of atoms in the molecule and to the so-called structural or constitutional formulas. The structural formulas of the two forms of butane, C_4H_{10}, are given, as illustrating the linkage of atoms, as well as the nature of isomerism.

$CH_3—CH_2—CH_2—CH_3$, $CH_3—CH<^{CH_3}_{CH_3}$.

Such formulas are not intended to represent the actual form of the molecule; they are schematic merely; they are not fanciful, but are based on innumerable experiments, which do not concern us here. The innumerable facts of organic chemistry tally so well with the assumption of chemical units or atoms, linked together in definite ways, as to give to the hypothesis a very great degree of probability.

Some atoms can manifest a different valency according to circumstances; thus iron forms two chlorides, $FeCl_2$ and $FeCl_3$, in the former of which the iron atom is believed, for good reasons, to have but two valences (Fe″), and in the latter three (Fe‴).

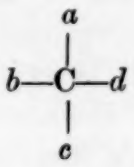
Of the cause of valency we know nothing, and in addition to what I have said we know but little, except that there is an intimate relation between the valences and the power of carrying electric charges, and that (in some cases at least) there is a definite geometrical relation between the valences.

If a salt, for example, sodium chloride, be dissolved in water, and an electric current be passed through the solution, the sodium atoms move to the negative pole, carrying charges of positive electricity, and the chlorine atoms to the positive pole, carrying negative electricity. These electrically charged atoms (or groups of atoms) are termed *ions*. If the chlorides of iron be similarly treated, a similar result follows, the iron transporting positive electricity. There is this difference, however, that the divalent iron atom in $FeCl_2$ transports but two units of electricity, while the trivalent atom in $FeCl_3$ carries three. More complex molecules are frequently broken up into a mixture of simple and complex ions, the latter carrying a unit of electricity for each free valence, thus K_2SO_4 gives two positive K ions and the negative ion $= SO_4$, which carries two units; with regard to the amount of electricity carried the valences are therefore equivalent. What the cause of the relation between valency and electrical phenomena is, we do not know.

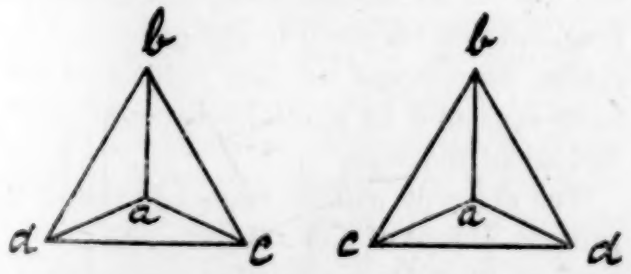
There is still another property of valency which has been discovered in recent years, and which is of the highest importance. It may be asked whether in the case of the carbon atom, for example, the division of the attractive power into four valences implies action in four distinct and fixed directions, that is, whether the atom possesses a sort of polarity, or whether the action may be in any direction. Thanks to the recent labors of organic chemists, it now seems tolerably certain that the carbon atom tends to exert its attraction in four distinct and tolerably fixed directions, rather than in all directions equally.

It has long been known that there exist certain pairs of organic compounds which have identical composition and molecular weight, which show identical chemical behavior and which agree in all physical properties except two. These bodies cannot be regarded as isomeric in the ordinary sense, as their structural formulas as usually written, are identical. The two respects in which they differ are these: in solution one rotates the plane of polarization of light to the right, the other to the left; when crystallized, they frequently show hemihedral faces, differing only in this, that the crystals of the one cannot be brought to coincide with those of the other, but are as an unsymmetrical body and its reflected image in a mirror. I have said that the ordinary structural formulas are schematic merely, they do not claim to show the actual relation of the atoms in space. Two molecules, whose geometrical forms are identical except in being right- and left-handed or as object and reflection, would be represented by the same structural formula, and would

have the same chemical, and in general the same physical properties; their action on polarized light, however, would be the same, but in opposite directions, and their crystalline form, if unsymmetrical, would be so in opposite senses. In short, the isomerism would not be chemical, but *physical* or *geometrical*, like the pairs in question. It was further observed that in every case of this kind the molecule contains an 'asymmetric carbon atom,' a carbon atom united with four atoms or groups each differing from the others:



If we regard the groups a, b, c, d as interchangeable in position, or as rotating independently about the central carbon atom, we cannot explain the apparent right- and left-handedness of the molecule; there could be no fixed difference between the two compounds. If, however, as van't Hoff and Le Bel pointed out, we suppose the four valences to extend in the directions of the apices of a tetrahedron and to be fixed in these directions; then when the combined groups are all different, we obtain two forms of molecule which are identical in every respect except that the one is like the reflected image of the other.



The figures represent two tetrahedra the centers of which are supposed to be occupied by a carbon atom, the four groups a, b, c, d being located in the direction of the apices. It is easily seen that the one corresponds to the reflection of the other in a mirror. It is to be distinctly understood that it is intended to represent only the direction of the valences, not the shape of the carbon atom. As, in general, these geometrical isomers are not readily transformed into each other, it follows that the combined groups or atoms have a strong tendency to retain their relative positions; in short, that the direction of the valences is practically fixed. The same holds true in the case of pairs of compounds in which there are two doubly united carbon atoms as

$$\begin{matrix} a \\ b \end{matrix}\!\!> C = C <\!\!\begin{matrix} c \\ d \end{matrix} \quad \text{and} \quad \begin{matrix} a \\ b \end{matrix}\!\!> C = C <\!\!\begin{matrix} d \\ c \end{matrix}$$

a simple rotation of one half the molecule about its axis, or an interchange of position on the part of a and b or c and d in one of these forms would convert it into the other, yet in reality this does not occur, and in general, the two forms represent distinct compounds. The theory has been applied with great success in predicting new compounds and in explaining the nature of substances containing several asymmetric carbon atoms in the same molecule, notably the sugar group. It does not imply that the molecule is rigid, but merely that there are certain fixed directions of attraction, about which, within limits, the combined atoms may vibrate. The concordance of a very great number of facts with this hypothesis, and the absence of any noteworthy exceptions, lend to it a high degree of plausibility. Whether the fixed direction of the valences is true of other atoms than those of carbon, is as yet uncertain. Carbon compounds lend themselves with especial ease to such studies, and the valency of carbon is practically fixed at four. The effect of varying valency, as in the case of iron, is unknown, but in the case of nitrogen, and to some extent in that of certain metals, some evidence has been accumulated, tending to show that the rule is a general one.

It will be seen that the theory of the

structural formula involves an extension of the older atomic hypothesis, in that it asserts definitely that the combining atoms do not blend, but come into juxtaposition in some orderly and systematic fashion, while stereochemistry, or chemistry in space, asserts that the parts of these systems are to a certain extent fixed in relative position, not rotating about each other after the manner of the members of the solar system. As to the inner nature of the atom itself, however, it says absolutely nothing.

To sum up, the laws of Constant and Multiple Proportions have led the chemist to regard matter as not continuous, but composed of units or atoms, these having the same mass and specific chemical properties in the same element, but other masses and other chemical properties in other elements. Innumerable facts lead him to believe that the atoms in the molecule are not blended, nor so juxtaposed as to have an arbitrary and constantly varying relation, but combined in such a manner that there is a more intimate relation between some atoms than others, some forming connecting links between the rest, a relation which is schematically represented by structural formulas. Finally, stereochemical phenomena indicate that the molecule possesses a certain definite geometrical structure, not necessarily rigid, but not having a mobility of its parts analogous to that of the parts of the solar system. As to the further divisibility of the atoms, their unalterableness, indestructibility, form, origin, and, in short, their absolute nature, the chemist knows nothing and has no opinion of real weight—for him they are merely centers through which energy manifests itself.

If those who adopt the atomic theory would carefully distinguish between essentials and non-essentials, and if those who deny the possibility of interpreting vital phenomena in terms of physics and chemistry would bear in mind that we know scarcely more of the inner nature of the fragment of carbon than of the protoplasm into whose composition it enters, and that affinity is after all is as great a mystery as consciousness, we might possibly hear less of the impossibility of gross, inert, dead matter containing within itself "the promise and potency of every form and quality of life."

H. N. Stokes.

---

*SOME OBJECTIONS TO THE ATOMIC THEORY.**

For the purpose of this discussion, all metaphysical conceptions or discussions are ruled out, and it is explicitly confined to that definition of the atom or molecule connoted by Dalton's famous hypothesis with such amplifications or modifications as have been brought about by the subsequent advance of physical science. In its inception the hypothesis was not without objectors, and properly so.

The efforts of Wallaston and others to insist upon the importance of considering 'combining numbers' or 'reacting masses,' things which one could really know about and determine experimentally, rather than hypothetical atoms, the existence of which in the nature of things was beyond physical proof, was philosophically sound, as far as it went. But the historical vicissitudes of the hypothesis, interesting though they be, can not be considered here, but rather, attention must be given to the comparatively recent discussions on this subject as they have appeared in contemporaneous epistemological writings.

The attempt will be made to present the present status of the subject with due regard to relative perspective values, rather than to cite article and authority in an historical retrospect. Dalton's hypothesis

* Paper read before the joint meeeting of the Chemical and Philosophical Societies of Washington. Time allotted for this contribution to the program, 15 minutes.

according to the generally accepted view of its genesis, was the result of an attempt to provide a mechanical explanation for the solution of a gas by a liquid. Under the influence of some force the particles of the gas are impelled, or diffuse among the particles of the liquid. The same is true of all solutions, the substance going into the solution disappearing as such. And furthermore, the solution, when in equilibrium, is homogeneous; consequently the particles must be very small though they remain discrete, and they must be uniform in mass, volume, and other properties.

The selection of the historical name atom for the particle did not necessarily imply anything more than has just been given. The apparently ready explanation these views gave for the laws of definite and multiple proportions which Dalton had already advanced, undoubtedly had a preponderating influence in bringing about their general acceptance. It is easy to see that granting the atomic hypothesis, the combination of two substances to form another, always identical, must be in definite proportions, or number of atoms or when there are multiple proportions they should bear a simple ratio to one another. But it is not easy to see how the atomic constitution of matter follows, as a necessary, if sufficient condition, from the laws of chemical combination, looked at purely objectively.

It would seem as though the human mind was so constituted that it necessarily demanded a mechanical explanation of recognizable phenomena. Indeed, some of our foremost thinkers apparently insist upon the truth of this proposition, and to Lord Kelvin, if memory serve me correctly, is credited the remark that he finds it impossible to understand phenomena for which he cannot construct a mechanical model, meaning mentally, of course.

It is natural that this feeling should exist. Our earliest impressions are associated with mechanical phenomena. These phenomena are intimately connected with our visual and tactual impressions, with just those senses, normally most cultivated, and most closely associated with the logical faculty. All through life a very large proportion of every day experience is with mechanical processes. We thus come to look for the 'mechanism' of all phenomena of which we become conscious, and when it is not obvious we supply it by analogies from better known phenomena; thus the tendency to reduce all phenomena to the lowest terms of matter and the three laws of motion. This leads to the consideration of the Herbartian School, which is hardly within the scope of this paper. The point to be made is that the conception of the atomic constitution of matter to explain the laws of chemical combination is not in itself susceptible of proof, nor in the nature of things is it probable that it ever will be; and that after all, as we have it to-day, it is nothing more nor less than an *analogy* with a conceivable mechanical process. This idea has been more or less clearly brought out sometime since by J. J. Thomson, Mach and others. It has been treated, though not perhaps specifically, by Ostwald, in his now famous paper on the 'Failure of Scientific Materialism,' wherein he very clearly indicates the ultimate weakness of mechanical explanations of phenomena where they long held sway, instancing the *ignorabimus* polemics resulting from the famous address of Du Bois-Raymond; and more familiar perhaps the development of the theory of light, from the corpuscular theory, through the undulatory theory with its hypothetical ether, demonstrated by Kelvin to be necessarily unstable and physically non-existent, to the recent electromagnetic theory; and cites Hertz with whose name this theory is so closely associated as declaring that he saw nothing in it but six differential equations, in an effort

to save it from the inherent weakness of a possible mechanical explanation. A further instance of the failure of mechanical conceptions to account for observed phenomena is cited in the attempt of Helmholtz, Clausius, Kelvin, not to mention less well known workers, to modify Mayer's conception of the equivalency of various forms of energy, by the notion that all forms of energy are fundamentally the same—mechanical energy. Whereas it has remained impossible to conceive of a working mechanism for certain forms of energy, this idea is no longer urged as an appendage to the original conception, though it is pointed out its freedom from any arbitrary hypothesis should have been a sufficient reason. In another place he calls attention to the arbitrary hypothesis in the kinetic theory of gases; of artificially neutralizing the properties of directions by assuming that collisions are taking place equally in all directions; and the consequent failure, when attempts are made to extend the theory to electrical energy for example. This has been clearly pointed out by Mach also.

What we know of the outside world is through our senses, inherently energy manifestations. Of what gave rise to the sensations we know naught but these energy phenomena, or differences of energy. We are not accustomed to regard them objectively however, and we conceive for ourselves a mental picture, a mechanical one, *matter*, which it is true we cannot attempt to disassociate from energy, as giving rise to the energy manifestations which we can and do know. And to this hypothetical matter are ascribed properties, the most striking being its permanency or 'indestructibility.' Says Mach, "all our effort to mirror the world in thought would be futile if we found nothing permanent in the varied changes of things. It is this that impels us to form the notion of substance."

The hypothetical existence of matter is then merely a mental effort to give a mechanical explanation to observed energy phenomena; not as will be presently indicated that it is necessary we should have a mechanical explanation of phenomena, but that it has become a habit of mind with us. And with the notion of matter and of matter as made up of discreet molecules or atoms, we bring in many other arbitrary hypotheses. In accounting for special phenomena we have modified our original hypotheses with special attributes to meet each specific case: the present notions regarding the asymmetric carbon atoms; space isomers and polymers in general; varying valency; complex or 'physical' molecules determining the symmetry of crystals, etc. It is not contended by any one that these hypotheses have not been useful. Indeed, in the field of organic chemistry it is not easy to see how it could have reached its present highly developed stage without them. But it is contended that with a realization of the exact position of the hypothesis with relation to the phenomena for which it seeks to account, should come a realization of the retarding influence it undoubtedly has had, and may have on the development of science. It has been well said, that "it would not become physical science to see in its self-created, changeable, economical tools, molecules and atoms, realities behind phenomena. Forgetful of the lately acquired sapience of her older sister, philosophy, in substituting a mechanical mythology for the old animistic or metaphysical scheme, and thus creating no end of suppositious problems. The atom must remain a tool for representing phenomena like the functions of mathematics."

But if it be philosophically weak to use this mechanical device in accounting for observed phenomena, because unnecessary, because it necessitates a constant modification by subsidiary hypotheses and finally shows

evident signs of being ultimately as futile as mechanical explanations in general have proved for all classes of phenomena the question immediately arises, why not abandon it? Especially when we are already in possession of so elegant and flexible a method for the statement of phenomena as is furnished by the language of mathematics.—An instrument so highly developed, so fertile in suggesting interrelations, by its facility in bridging long mental processes as often to create an uncanny feeling to which the great Euler gave expression, that "his science in the person of his pencil surpassed himself in intelligence."

Should we not rather agree with Mach who has defined physics (including of course all physical science) as "experience arranged in economical order," that the "aim of research is the discovery of the equations which subsist between the elements of phenomena."

This I take it may be regarded as a fair presentation of the 'phenomenology' or, 'mathematico-physico-phenomenology' point of view in contradistinction to that of 'atomistics.' Of the many contributions to the discussion, direct or indirect which contemporaneous literature furnishes, perhaps the most notable is from Boltzmann. He insists that both methods of presenting phenomena are but *methods;* that each possesses inherent advantages, that neither can with fairness be dogmatically declared superior, and until it shall have come about that the one has absorbed the other, both methods should be developed together. By both methods it is possible to present *comprehensive* conceptions of fields of phenomena not possible to direct description. But we should guard against introducing any unnecessary arbitrariness, rather than follow Ostwald in attempting no concept at all. That as a matter of fact, the concepts of the calculus rest fundamentally on the notion of a finite number of elements; otherwise the theory of limits has no meaning and the differential equation does not represent a possibility. This is of course an essentially atomistic conception.

In avoiding arbitrariness as far as possible, by assigning as few properties as may be necessary to the atoms in any particular field of phenomena, we obtain special hypotheses.

Phenomenology attempts to co-ordinate these special hypotheses in one concept. There are at least two difficulties; the corresponding differential equations differ, making their comparisons a very complicated matter; they relate to stationary or nearly stationary conditions and cannot fairly represent turbulent reactions. The 'energetic phenomenology' attempts to consider what is common to these various fields, such as the energy laws, but fails because its results are too general, and the analogies are not applicable in all details.

Atomistics would attempt to co-ordinate these fields, by modifying the assigned properties of the atoms, and thus obtain a simultaneous, comprehensive view of the whole, to an extent not approached by phenomenology. Further, by this method some notion is to be had of turbulent actions. But the assigned properties of the atoms must be in accord with the special concept of the phenomenology, and therefore this latter should be developed also. So that atomistics, though they have hindered progress at times, still have a use. And the danger is in confusing the phenomenology of results alraedy established with the atomistic hypotheses which sever to hold them together.

Volkmann suggests a further qualification to these views to which Boltzmann assents, dividing physical phenomena into three classes: Coarser phenomena as elasticity or capillarity, where atomistic hypotheses are unnecessary; finer phenomena as electrolyses, dispersion of light, etc., when

atomistics may be useful; and a middle field when the usefulness of atomistics is doubtful, and to this last field only does Boltzmann's contention apply that both methods should be developed together.

Whether or no we may agree with Boltzmann as to the atomistic basis of the calculus, or the propriety of Volkmann's classification, we shall be inclined to hold his main contention as sound and conservative, albeit on utilitarian grounds. Both the language of mathematics, the medium of expression of the phenomenologist, and that of the atomisticist are but methods, after all, human instruments, ingeniously devised and beautifully developed, but merely instruments.

Whether we shall obtain a theory for observed phenomena which shall be as comprehensive as the atomic hypotheses without its adherent drawbacks, as flexible, as labor saving, as suggestive as the calculus, without its complexity in certain desired applications, by the absorption of one method by the other, it is not possible to say as yet. Quite possibly the ideal theory is to come from an entirely different direction. But for the present we must use those instruments which are at hand, and as long as they prove useful each in itself is worth the highest development we can give it. The idea expressed by one of the previous speakers this evening, that the coming generation will shake off the fetters of 'mechanism' and concern itself with 'parameters' may be true, but it seems to me a rather bold prophecy. More likely is it that notions of the 'atoms' and 'parameters' will develop side by side, the distinguishing feature of their study being a clearer view, a *realizing sense* of their exact relationship to phenomena. And with this it seems fair to assume will come those new principles which Ostwald has prophesied to account for phenomena, where the 'energistics' has failed and whose form it is futile to predicate at present.

To this end the discussion was probably necessary and should prove most useful. It is to be regretted that the time allotted me will not suffice to call to your attention the views of other thinkers on this most interesting subject. I trust that what I have been able to bring before you will at least indicate the status and importance of the subject.

Frank K. Cameron.

ON ARTIFICIAL PARTHENOGENESIS IN SEA URCHINS.

In the last October number of the *American Journal of Physiology* I published a preliminary note on the artificial production of larvæ from the unfertilized eggs of the sea urchin. I mentioned that unfertilized eggs were able to develop into normal plutei after having been in a solution of equal parts of a 20/8 n $MgCl_2$ solution and sea water for about two hours. The control experiments by which the possibility of a fertilization of these eggs through spermatozoa had been excluded were briefly mentioned. In the April number of the same journal a full description of my experiments was published which I believe puts an end to any doubt concerning the possibility of an error. Nevertheless I decided to repeat these same experiments with the additional precaution of using *sterilized* sea water. Through the kindness of the board of trustees of the Elizabeth Thompson Fund I was enabled to make further experiments on artificial parthenogenesis at the Pacific Coast. These experiments have led to a number of new results which will be published in the *American Journal of Physiology*. Here I will confine myself to a description of the precautions which were taken in these experiments to exclude the possibility of a fertilization of the eggs through spermatozoa.

The sea water used for these experiments was heated the day before, very slowly, to

a temperature of from 50 to 70° C. and was kept at that temperature for about ten minutes and allowed to cool very slowly. The control experiments proved that, as was to be expected, the spermatozoa are killed by this treatment. During the time the water was heated no sea urchin was opened in the laboratory or was even kept there. The sterilized sea water was kept in special flasks and covered jars which were utilized for this purpose only. Before we started an experiment we disinfected our hands thoroughly with soap and brush in the same way as is customary in a surgical operation. Every sea urchin before it was opened was exposed for from two to five minutes to a powerful stream of fresh water and care was taken to wash the whole surface of the animal as thoroughly as possible with fresh water. The mouth of the sea urchin was then cut out with scissors that had been sterilized the day before in the flame and had been kept dry since. Through the excision of the mouth the sexual glands were exposed and their color allowed to decide whether the animal was a male or a female. If the first animal that was opened was a female the intestine was removed with a sterilized forceps and care was taken not to bring the forceps in contact with the ovaries or with the outside surface of the animal. After the intestine had been removed and nothing left except the ovaries, the inside of the animal was repeatedly filled with fresh water and washed out. Then each of the five ovaries were taken out *in toto* with a sterilized section lifter and special pains were taken that the ovaries did not come in contact with the surface of the sea urchin or with the hands of the experimenter. The ovaries were first put into a dish of fresh water, were washed off carefully and then put into sterilized sea water.

One part of the eggs was put into sterilized sea water to serve as control material. A second portion was put into a mixture of equal parts of sterilized sea water and a 20/8 n $MgCl_2$ solution. An hour or two later these eggs were taken out of this mixture and put into sterilized sea water. While of the latter eggs as many as 25 per cent. developed into blastulæ and swam around the next day, not an egg of the control material even segmented. We spent hours searching the control material for segmented eggs but were never able to find a single one.

In addition to these control experiments we made several others. It was necessary to apply the mixture of equal parts of the 20/8 n $MgCl_2$ solution and sea water for from one to two hours in order to bring about the development of the unfertilized eggs. We made it a rule to take out one portion of eggs from this solution much earlier—in some cases after ten minutes. In no case did one of these eggs segment or develop.

A third series of control experiments was applied. Solutions with less $MgCl_2$ and more sea water were tried. In solutions of 30 cc. 20/8 n $MgCl_2$ and 70 cc. sea water not an egg was able to develop.

If the first animal opened in these experiments happened to be a male the instruments were at once laid aside for disinfection and the next animal was opened by another experimenter with the same precautions.

In some experiments we used sea water that had been filtered through a new Pasteur filter. Although no spermatozoa are able to pass through such a filter, the eggs treated with a mixture of equal parts of a 20/8 n $MgCl_2$ solution and filtered sea water developed while none of the control eggs were able to develop.

In one of the former papers I mentioned the fact that the mixture used for artificial fertilization killed the spermatozoa in a comparatively short time and injured many

of the eggs. Contrary to the common prejudice, it is a fact that spermatozoa are much more sensitive and are killed much sooner than the egg.

My experiments at Pacific Grove were carried on with *Strongylocentrotus franciscanus* and *purpuratus*. In both animals artificial parthenogenesis can easily be accomplished.

In the experiments at Pacific Grove I enjoyed the valuable assistance of Mr. W. E. Garrey.

Jacques Loeb.

The University of Chicago.

April 3, 1900.

A CURIOUS PHASE OF INTER-STREAM EROSION IN SOUTHERN OREGON.

The 'Rogue River Valley,' in southwestern Oregon, is one of the five great depressed areas of the Pacific Coast country, which separate the Klamath and Coast ranges from the Sierra Nevada and Cascade Mountain systems. Its main stream, the Rogue River, issues from deep cañons in the Cascade Range, and flows thence, in its middle course, through a broad valley whose floor is a flat plain, two to five or more miles in width. In crossing the basin, the stream found soft strata to work upon, and not being obliged to cut deep, it eroded a broad valley, strongly contrasting with the cañons above and the narrow, rocky gorge in which the river makes its passage through the Klamath Mountains near the sea. All the tributary streams within the area of the basin have eroded similarly broad, flat-bottomed valleys, and between them they have reduced to a local base-level, the greater portion of an area forty or fifty miles in length by twenty to thirty miles in width. Within these limits there are many hills and low mountains, remnants of the Tertiary strata in which the broad valleys are excavated, but they are quite insignificant in comparison with the high mountains which enclose the basin, of which the Siskiyou range on the southwest rises to 7000 feet and over, and the Cascades on the east to 6000 feet on the average, surmounted by the beautiful volcanic, snow-clad cone of Mt. Pitt.

Since the partial base-leveling of the 'Rogue River Valley,' which doubtless was accomplished nearly at sea-level, the territory has been elevated and the basin tilted, mainly toward the northwest. The valley plain descends from an altitude of about 1900 feet at Ashland to less than 1300 feet where the C. & O. R. R. approaches the Rogue River. In ascending along the river, the gradual rise in the plain is everywhere quite perceptible, and it has attained an altitude of approximately 2000 feet where the main stream issues from the foot-hills proper of the Cascade Mountains. This tilting has increased the gradient of the streams, causing them to cut below the old level, and all the principal ones now flow in comparatively narrow, sharp-cut, cañon-shaped troughs, excavated from 30 to 75 feet below the valley plain. These cañons are few and widely separated, telling of the youthfulness of this new cycle of erosion.

The inter-stream tracts are broad plains, undissected by deep gulleys. Some portions of them are without timber or even chaparral, although generally supplied with a sparse growth of grass, and in the vernacular of the country are known as deserts. It is on these 'deserts,' some of which are four or five miles in length and one to three miles in width, that is developed the peculiar type of surface erosion which has given rise to this paper.

When viewed from a distance, the surface of the 'deserts' appears to be remarkably even, suggesting an absolutely uneroded, water-laid deposit such as might result from the complete filling of a broad, shallow lake basin. But, upon endeavoring to cross these barren plains in the rainy

season, the traveler is unpleasantly made acquainted with the fact that the whole surface is cut up by a system of shallow gulleys or gutters, in which water commonly stands, but there is rarely observed a flowing stream. This system of gulleys is not of the familiar dendritic type of other regions. The gutters are all connected, but branch and inter-branch in a very confusing manner. There seem to be no trunk streams (properly so called) and tributaries. In fact, there is a perfect net-work or labyrinth of gutters carved into the surface of the plain, completely surrounding and isolating low, gently rounded mounds of gravelly material from 30 to 150 feet in diameter, and whose tips represent the original plain surface of the valley floor, and give these 'deserts' their apparent evenness as seen from a distance.

The gutters are from 3 to 30 feet in width, and are constantly narrowing and widening from no cause which has yet appeared. Sometimes they head in a small rounded basin, 30 to 50 feet in diameter. Indeed, it may be said that the whole system is made up of rounded, elongated basins, connected by narrower channels. *Yet whatever may be the width, all portions of these gulleys are trenched to about the same depth beneath the original surface, namely, about 3 feet.* The little basins at the heads are as deep as the gulleys on the borders of the 'deserts' where they are about to enter the cañon valleys of the main streams. They are floored with rounded, waterworn cobbles of black volcanic rock, of comparatively uniform size, and never seem to contain any ordinary stream deposits such as gravel or sand.

The settlers of the region commonly refer to these depressions, containing standing water during the rainy season, as 'pot-holes,' but it is obvious that they do not represent the typical remolinos or pot-holes of stream-bed erosion. I have the following explanation to offer: The surface formation of these 'desert' tracts is a bed of obscurely stratified, water-laid gravel and sand, containing a scattering of waterworn cobbles. The material has come largely out of the Cascade Mountains, as is indicated by the large numbers of fragments of chalcedony, agate and opal scattered over the 'deserts.' It was spread far and wide across the valley floor by the Rogue river and tributaries, perhaps during a short period of slight depression, and probably is the equivalent in taxonomic position of the Red Bluff gravels of the Sacramento Valley (of about the age, it seems to me, of the Illinoian drift-sheet of the Mississippi Basin). The cañon valleys have been carved since, trenching this gravel formation and cutting into the harder Tertiary rocks below. They reveal to us the fact that the gravel is only a thin layer, usually not much exceeding three or four feet in thickness, spread over the beveled edges of the older formations, which were base-leveled to form the general even floor of the valley.

During ordinary seasons, the erosion of the gulleys proceeds very slowly or not at all, but I learn from the inhabitants that at certain times, not often occurring, after very heavy rain storms, there is a decided movement of the water in the gutters, and at such times, the finer material of the gravel formation may be removed and carried into the cañons, while the cobbles remain behind to encumber the flat floors of the depressions. This erosive action is only active as far down as the base of the gravel, where the much harder volcanic rock is encountered, and this may account for the remarkably uniform depth of the gulleys. Their varying width and the labyrinthine character of the system may be due to some structural feature of the gravel formation, not appearing upon a casual examination.

OSCAR H. HERSHEY.

BRAGDON, CALIF.,
Feb. 5, 1900.

THE SIXTY-SEVENTH ANNUAL REPORT OF THE COAST AND GEODETIC SURVEY.

THE Report of the Superintendent of the Coast and Geodetic Survey for the year ending June 30, 1898, has just made its appearance from the Government Printing Office, in Washington. The publication has been somewhat delayed on account of numerous changes, both in form and matter.

A striking feature of the new report is the absence of large folded maps in the body of the work. The plan has been generally adopted of showing, by cuts, only such work as has been accomplished during the year, and to this end, all large illustrations are reduced to single or double page plates. Where clearness is equally served, small cuts are run in the text, thus very much adding to facility of description, as well as making the volume more convenient and economical. Two large progress maps are placed in a pocket at the end.

The type is of a pleasing character, known as French Old Style, and gives the page a clean open appearance. A departure has been made from the usual custom, in the matter of binding and margin. The type page is somewhat smaller, while no change has been made in the size of the leaf. The sombre black of the cover has been replaced by a grateful olive tint; the Coast and Geodetic Survey seal appears on the back, and the flag, a newly acquired insignia, ornaments the front. Withal, the book is not so large as the average one for previous years, owing partly to the elimination, already noticed, of the large unwieldy folded maps, and partly because of the omission of some matter hitherto published but now regarded as unessential in a general statement of the activity of the Bureau.

The whole subject is treated under four heads, viz:

I. The Survey and its Progress.
II. The Scientific and Technical Results.
III. The Administration.
IV. The Appendices.

Under the first head is an introduction, in which the appropriations are stated, and a general summary of the work of the year is given. This outlines the course of the work, and treats of the re-survey of Chesapeake Bay and San Francisco Bay; of the explorations in Alaska and the Pribilof Islands; and of the geodetic operations throughout the interior of the country. Notice is taken, also, of the forms of publication: (1) of charts and maps, and (2) the textual publications.

The aid given to the military and naval authorities in the war with Spain is touched upon. Soon after the outbreak of hostilities thirty officers were withdrawn from the service, and three vessels, the *Patterson*, *McArthur* and *Gedney*, on the Pacific Coast, were temporarily transferred by the President to the navy. On the Atlantic Coast, the *Bache* was used as a dispatch boat between Key West and Havana, and rendered important service in connection with the '*Maine* disaster.' In addition to the collation and preparation of information regarding maps of Puerto Rico, Cuba, Hawaii and the Philippines, the Survey furnished to the Navy Department, between April 1st and June 30th, over 27,600 charts.

Mention is made of the fact that at the close of the fiscal year there were 375 persons employed in the service, including petty officers and sailors. The total cost of the work is stated as follows:

Field expenses	$124,800
Vessels (including $75,000 for the *Pathfinder*,	110,000
Salaries	226,870
Office expenses	34,400
Making a total of	$496,070

To this is to be added an amount of $112,676, from the Naval Appropriation Bill, for pay and subsistence of enlisted men, as well as $45,354, for the pay of naval officers, making a grand total of

$654,100, as the cost of the survey during the fiscal year described.

Following the introduction is an historical sketch of the Coast Survey, stating briefly the phases through which it has passed since its inception, in 1807, and also giving a list of the Superintendents, from the beginning to the present time. As a matter of interest, a sketch is shown giving the outline of the first triangulation laid out on this work. It consists of 11 trigonometrical points in the vicinity of New York, suitably connected by triangulation, and determined and verified by the measurement of two base lines. This work was done as early as 1817.

Passing to the second division of the report, the scientific and technical results, we find the work classified into:

(1) Coast Work.
(2) Geodetic Work.
(3) Magnetic Work.
(4) Special Operations.
(5) Publication of Results.

Under *Coast Work*, a general statement is given of the progress made in Buzzard's Bay, Chesapeake Bay, Lake Pontchartrain, San Francisco Bay, Washington Sound and Alaska. Mention is made of some miscellaneous charts, and finally a list of hydrographic sheets is given, published through the courtesy of the United States Fish Commission, and referring to the work of the steamer *Albatross* in Southeastern Alaska, under the direction of Commander J. F. Moser, U. S. N.

The details of field operations comprise a description of the work accomplished in the different localities in hydrography, current observations, topography, etc.

Besides the regular coast work, a party was sent to the Pribilof Islands, and during the season, which was an exceptionally favorable one for surveying operations, a complete topographical survey was made of St. Paul, St. George, Walrus, and Otter islands, on the scale of 1/20,000. Not only this, but the seal rookeries, to the number of eighteen, were completely developed, and maps of them were carefully drawn, on a scale of 1/2000. These show every necessary detail, and furnish most valuable information touching upon the seal industry.

In January, 1898, an appropriation of $100,000 was made by Congress, in order that immediate information might be secured in regard to the mouth of the Yukon and other rivers leading to the gold producing regions of Alaska. Three parties were sent out in the spring, and valuable results were obtained from all the localities visited. Special attention was given to the mouths of the Yukon and Copper rivers, the region around the head of Lynn Canal, and the passes leading to the Klondike.

The work of the Coast Pilot Division is briefly stated, and mention is made of the fact that the issue of the U. S. Coast Pilot for the Atlantic Coast has increased from 1209 copies during the year 1897, to 1532 copies for the following year.

Prominent among the work accomplished in the Tidal Division during the year was the preparation and completion of Parts I. and II. of a 'Manual of Tides,' by Dr. R. A. Harris. These two parts were published as Appendices Nos. 8 and 9 of the Annual Report for 1897. It is proposed to treat the whole subject in five parts. Part III., because it was immediately wanted, appeared first, and was published as appendix No. 7 in the Report for 1894. Parts IV. and V. will appear shortly.

Part I. is a historical treatment of the subject. Part II. refers to tidal observations, the equilibrium theory, and harmonic analysis. Part II. is on connections between harmonic and non-harmonic quantities, including applications to the reduction and prediction of tides. Part IV. will treat of tidal theory; and part V. of tidal streams or currents.

The *Geodetic work* of the survey for the fiscal year considered, is treated under the subjects of reconnoissance, triangulation, hypsometry, astronomical, and gravity work. These have been carried on in all three divisions of the United States, the Eastern, Middle, and Western, and also in Alaska. Gravity work was done on the Pribilof Islands, with a standard set of pendulums.

The *magnetic work* has been generally distributed over Maryland, District of Columbia, Virginia, West Virgina, Ohio, North Carolina, California, Washington, and Alaska. The magnetic survey of Maryland, made by Dr. L. A. Bauer, under the auspices of the Geological Survey, is noted in connection with the regular work of the Coast and Geodetic Survey. This work was carried out with instruments loaned by the Survey, and in return for their use the Government was to have access to the results, when desired.

Of *Special Operations* may be cited the location of buoys, the establishment of speed trial courses for ships of the Navy; magnetic ranges and dock lines; State boundary lines, and detailed hydrographic surveys. Observers have been sent with exploring parties, where there was prospect of securing valuable geographical knowledge.

In the *Division of Publication* a description is given of the processes employed in chart production. The plane-table sheet, as it comes from the hands of the field officer, is followed through the different stages of reducing, engraving and printing, until it appears as a finished chart, ready for distribution. More than 100,000 charts were issued during the year.

Of the textual publications there are the annual reports and scientific appendices, the bulletins, notices to mariners, tide tables, coast pilot, and special publications. A bulletin, entitled, 'Tables of Depths for Channels and Harbors on the Coast of the United States,' has been issued. The regular notices to mariners, over 4000 copies of which are sent out monthly, and tide tables, which now include about 3000 ports throughout the world, were published during the year. The predicted time of every high and low water, throughout the year, is given for 70 principal ports, of which 25 are within the territory of the United States. As a special publication may be noted, 'Magnetic Ranges for Determining Deviation of the Compass in San Francisco Bay.' The catalogue of charts published by the Coast and Geodetic Survey at present contains a list of about 500 charts and maps.

Under the general head of 'Administration,' may be noted a table giving the details of field operations, followed by a summary of the work accomplished in the Office of the Assistant in Charge of Office and Topography, as well as in the Office of the Hydrographic Inspector and the Office of Standard Weights and Measures.

Under the title *Assistant in Charge of Office and Topography*, the routine work and the results obtained in the following divisions are described:

(1) Computing.
(3) Tidal.
(3) Drawing and Engraving.
(4) Chart.
(5) Instrument.
(6) Library and Archives.
(7) Miscellaneous.
(8) Disbursing.

In the report of the *Hydrographic Inspector* appear statements in regard to vessels and officers; the hydrographic section, and the coast pilot party.

The important work of the *Office of Standard Weights and Measures* is given only in outline. Much time was given by Mr. Braid, the officer then in charge, to the consideration of questions relating to sugar importation. Standard bars of length were supplied to the Ordnance Department of

the Army, for use in the manufacture of great rifles. Progress was made in designing apparatus for the comparison of electrical standards; and standards of length and mass were furnished as requested, to State and municipal authorities, to corporations, and to individuals.

As a special feature in the operations of the fiscal year for which the report is made, may be mentioned the tide and current observations in Seymour Narrows, Alaska; where, by permission of the Canadian Government, a tide gauge was established, and times of slack water during day hours, from April 18th to October 14th, were observed. Predictions based on this and other information have since appeared in the tide tables, and are a valuable acquisition to the information there found.

During the year a contract was let for the steamer *Pathfinder*, to be constructed especially for the Alaskan work. She is the largest of the Coast Survey fleet, now numbering 11 steamers and five sailing vessels, and has a displacement of about 875 tons, with a steaming radius of 7000 miles. This vessel has already made the trip from New York to San Francisco, by way of Cape Horn, and has proved herself to be an admirable sea-going vessel. She is now stationed in the Hawaiian Islands, engaged in hydrographic work, but will soon come north to take up the operations for which she is especially fitted by her construction, namely, the hydrography on the rock-bound coasts of the Aleutian Islands.

The reconnoissance and the triangulation has been carried on along ninety-eighth meridian, and much progress has been made. This is later to be connected with the Mexican work on the south and the British on the north, and altogether will furnish an arc of the meridian, second to none, for the determination of the earth's figure. The great arc across Russia, from the North Cape to the Baltic, was considered a great achievement, but the combined British, American and Mexican arc will probably stand without a rival for many years to come. This, combined with the arc of the parallel, the results of which are now deduced, and the report of which is running through the press, will completely determine the earth's figure for the continent of North America.

The important connection across the Peninsula of Florida, from Fernandina on the east to Cedar Keys on the west, has been made and is reported in the present volume. This completely binds together the somewhat loose tertiary triangulation on the eastern coast with that on the western, and aids materially in the correct determination of all geographical positions on the coast of Florida.

Following the traditions of the Coast and Geodetic Survey in the question of State boundaries, assistants were detailed to aid the commissioners of Maryland and Virginia in the location of the line between the two states. This was completed in January of the fiscal year. Other important side operations were the special hydrographic examination of the Tybee Submerged Breakwater, made at the request of the War Department; services on the Mississippi River Commission; hydrographic surveys at Key West and the Tortugas, made at the request of the Navy Department; and operations undertaken in compliance with special acts of Congress. Under the last head may be stated the survey of the Brunswick Outer Bar, Ga., which, on account of the extreme accuracy required, necessitated prolonged and careful examination. Aid was given in the private expedition undertaken during the year, to Mt. St. Elias, and although the expedition was unable to reach the top, valuable information of the region was procured.

In the fourth part of the work appear the Appendices. Of these there are nine, and the subjects treated are:

Nos. (1), (2), (3) Precise Leveling, in Kansas and Colorado.

No. (4) The Peruvian Arc, its relative Value, etc.

No. (5) Physical observations made in connection with the Pribilof Islands Expedition of 1897; in which the magnetic irregularity on St. George Island, the sea water densities in the North Pacific and Bering Sea, and the determination of the force of gravity on St. Paul Island, are all treated.

No. (6) A report on the Proceedings of the International Geodetic Association, and on Geodetic Operations in the United States; comprising statements with reference to the international latitude service, gravity measures, the figure of the earth, the Peruvian arc, and the longitudes of Paris and Greenwich. Under Geodetic Operations in the United States are treated; base lines, triangulations and arcs, astronomical work, miscellaneous operations, past and future operations, and the work of the United States Engineers.

No. (7) The Determination of Time, Longitude, Latitude, and Azimuth; in which the method of making these observations and computations is treated fundamentally. This paper is the fourth edition of an appendix to previous Coast Survey reports. It is now brought up to date, and embodies the most recent knowledge on the subject. A description is given of the most approved practical methods developed from field experience during half a century.

No. (8) A Plane Table Manual, in which are given the field methods employed with this valuable and convenient instrument. The subject is treated under: I. A preliminary statement; II. The instruments and adjustments; and III. The field work. Under the latter head the three-point problem is treated at length, and numerous tables are given, among which may be noted one for computing differences of elevation, one showing heights corresponding to angles of elevation, and one giving corrections for effect of curvature and refraction.

No. (9) Problems of Physiography concerning Salinity and Temperature of the Pacific Ocean—closes the report and is treated in three heads: Bering Sea, Okhotsk Sea, and the Central Pacific Ocean.

There are 25 cuts in the body of the work, besides 55 in the different appendices. Many of these are half-tone illustrations and add materially to the value and appearance of the Report.

E. D. P.

SCIENTIFIC BOOKS.

Clark University, 1889–1899. Decennial Celebration. Worcester, Mass., Published by the University. 1899. 4to. Pp. 566.

Of the three verbs to *be*, to *do*, and to *know*, the great majority of young men unhesitatingly regard the second as expressing the ultimate purpose and end of life. This is, as a matter of course, the idea of the practical man, who knows what he wants, and does not desire to want anything else. The average trustee of an American college will think it a very commendable thing for a professor to employ all the time he can possibly save in making money; but if he devotes much energy to any purely theoretical research, the trustees will look upon him askance, as a barely respectable squanderer of his opportunities. In England, this notion takes a turn that really makes it a little less gross; yet being foreign, perhaps we can discern its error more easily than in its more familiar guise. Thus, Dr. Karl Pearson, in the introduction to his 'Grammar of Science,' deliberately lays down the principle that no end whatever is to be approved without a reason, except the end of the preservation of society; and applying this rule, declares that the only valid excuse for the encouragement of scientific activity lies in its tending to maintain 'the stability of society.' This is a truly British phrase, meaning the House of Lords and vested rights and all that. Only recently, we have seen an American man of science and of weight

discuss the purpose of education, without once alluding to the only motive that animates the genuine scientific investigator. I am not guiltless in this matter, myself; for in my youth, I wrote some articles to uphold a doctrine I called Pragmatism, namely, that the meaning and essence of every conception lies in the application that is to be made of it. That is all very well, when properly understood. I do not intend to recant it. But the question arises, *what is* the ultimate application; at that time, I seem to have been inclined to subordinate the *conception* to the *act*, knowing to doing. Subsequent experience of life has taught me that the only thing that is really desirable without a reason for being so, is to render ideas and things reasonable. One cannot well demand a reason for reasonableness itself. Logical analysis shows that reasonableness consists in association, assimilation, generalization, the bringing of items together into an organic whole—which are so many ways of regarding what is essentially the same thing. In the emotional sphere, this tendency towards union appears as Love; so that the Law of Love and the Law of Reason are quite at one.

There was a simple fellow who, in a benighted age and land, wandered about uttering appreciations of the elements of human life which have made an extraordinary impression upon most of us. Of all his sayings, there is none whose truth has been brought home to me more strongly by what I have been able to detect in successful men and women than this: Whoever makes his own welfare his object will simply ruin it utterly: *ὁ εὑρῶν τὴν ψυχὴν αὐτοῦ ἀπολέσει αὐτήν.* American education, for the most part, is directed to no other object than the welfare of the individual scholars; and thereby incites *them* to pursue that object exclusively. A great university bears upon its seal the remark of its founder: "I wish to found an institution where any man can learn any thing." It was a noble idea; and it would be mean to pick flaws in it—especially as he did not say what ulterior purpose he might have in view. But the university which parades this casual remark as its motto, seems to proclaim to its students that their individual well-being is its only aim. Our scientific schools distribute circulars which dwell chiefly upon the handsome incomes their alumni are making, thereby calling up such images as a handsomely laid table with a pair of Hâvre-de-grace ducks and a bottle of Château Margaux. What comes of such a conception of education and of life, for surely, the purpose of education is not different from the purpose of life? The result is that, notwithstanding all the devices and tricks of the American teachers' art, it may be doubted whether any teaching ever anywhere did less to make happy men and women. At any rate, the spiritual meagerness of the typical American school-book is extreme. The great medieval universities, the modern German universities, the new science colleges of England, which did, and do, great things for their students personally, were never in the least founded for their students' individual advantage, but, on the contrary, because of the expectation that the truths that would be brought to light in such institutions would benefit the State. This end was, and is, so constantly in view that the scholars are led to regard their own lives as having a purpose beyond themselves.

Yet even this is a low view of learning and of science. No reader of this JOURNAL is likely to be content with the statement that the searching out of the ideas that govern the universe has no other value than that it helps human animals to swarm and feed. He will rather insist that the only thing that makes the human race worth perpetuation is that thereby rational ideas may be developed, and the rationalization of things furthered.

No other occupation of man is so purely and immediately directed to the one end that is alone intrinsically rational, as scientific investigation. It so strongly influences those who pursue it to subordinate all motives of ambition, fame, greed, self-seeking of every description, that other people, even those who have relatively elevated aspirations, such as theologians and teachers, altogether fail, in many cases, to divine the scientific man's simple motives. The Clark University, in recognizing the pursuit of science as its first object, with teaching,—of course, an indispensable means of securing continuity of work,—as only a subordinate, or at most a secondary object, has perhaps

the most elevated ideal of any university in the world; and I believe it to be so much the better for the individual students. At any rate, I can only record my personal observation in two visits, after having endeavored at many universities to learn to appreciate the atmospheres of such places, that there is a sweetness and a strength there quite exceptional. I am far from regretting that the institution has been through tribulations, and has purged itself of every element alien to its idea. To-day the good seed has germinated, so that it can no longer be choked by lower motives if it now only receives what is necessary to its continuance. It is earnestly to be hoped that it may speedily find its Constantine or its Helena. If not, one can but pity the family of its founder, which will have missed so narrowly a crown of high distinction. In that case, one must believe that among the American people, so appreciative of broad ideas, there may be found some thousands of persons, who whether they are quite sure of the immeasurable superiority of the aims of Clark or not, will at any rate feel that one institution of this peculiar kind ought to exist in the land, and will come forward with annual subscriptions to enable it to tide over a prolongation of its period of trial, and to wait for the rescue that sooner or later, from some quarter or another, is sure to come. The volume before us affords indisputable proof of the extraordinary interest and respect which this small institution commands from every genuine man of science the whole world over. Mr. Clark has, at any rate, drawn the eyes of all Europe with expectation upon the city of Worcester. To allow the university, after this, to sink into nothingness would be to make a nasty smirch upon the scutcheon of America, that would long remain an offence to all our eyes.

C. S. Peirce.

Analysis of White Paints. A Collection of Notes on the Chemical Analysis of White and Tinted Paints. By George H. Ellis, B.Sc., Analytical Chemist and Assayer. Late Chemist Chicago, Burlington and Quincy Railway Company. The Technical Press, Evanston, Ill. Pp. 61 + vi.

This little book is a reprint of a series of papers originally published in the *Paint, Oil and Drug Review*, and their aim is to give a detailed description of the best methods of analysis of white and tinted paints. The book is intended not only as a reference book for experienced chemists, but also as a complete manual for the use of those who have little knowledge of chemistry. Thus a full description is given of the analysis of clay. It is a lamentable fact that so many manufacturers who are just coming to feel the need of a chemist in their works, do not recognize the desirability of having as chemist one who has at least a moderately thorough knowledge of chemistry. A book like the one before us will be of great value to the inexperienced paint-chemist, and will not come amiss to others. It will be of most value, however, to those chemists into whose hands there comes only occasionally a sample of paint for analysis. Chapter 1 is on preparing samples for analysis. Chapter 2 describes the different white pigments, and their qualitative and quantitative analysis, with specimen analyses by the author. The pigments considered are calcium carbonate, gypsum, china clay, silica, barium sulfate, magnesium carbonate, magnesium silicate, zinc oxid, and white lead. Chapter 3 presents schemes for the analysis of mixed paints, a problem often difficult owing to the presence of several different pigments as well as perhaps adulterants. The methods given are excellent and are described with clearness. The use of barium carbonate as a white pigment is referred to only in a brief note, where it is stated to be little used in American paints. I do not recall having seen any mention elsewhere of its use, but a highly praised paint came into my hands lately, which consisted of nearly equal parts barium carbonate and zinc oxid.

An appendix gives a brief scheme for the estimation of turpentine, benzin and water, a list of the principal pigments with their trade names, atomic weight table, and metric conversion table. The book has a full index. It is to be hoped that the author will supplement this book by a similar one on colored pigments and tints and their analysis.

Jas. Lewis Howe.

The Refraction of the Eye, Including a Complete Treatise on Ophthalmometry. A Clinical Text-

book for Students and Practitioners. By EDWARD DAVIS, A.M., M.D., Adjunct Professor of Diseases of the Eye in the New York Post-Graduate Medical School and Hospital, etc., with One Hundred and Nineteen Engravings, Ninety-seven of which are Original. 8vo. Pp. XII, 431.

This book as indicated in its sub-title is practically a treatise on Ophthalmometry. Replete with illustrative cases showing the most accurate and the most certain of the methods that are employed by the author for the examination and correction of errors of refraction, it serves as an excellent clinical guide for both the beginner and the experienced practitioner in this particular line of ophthalmic practice.

Well written, devoid of confusing diagrams, and most comprehensive in its every detail, it can be safely asserted that the book is by far the best exposition of the value and the use of the ophthalmometer that we have in our possession at the present time.

Both the author and the publisher are to be congratulated upon the production of a valuable work.

C. A. O.

SCIENTIFIC JOURNALS AND ARTICLES.

The Journal of Physical Chemistry, January. 'On the Inversion of the Hepta- and Hexa-hydrates of Zinc Sulphate in the Clark Cell,' by H. C. Barnes; 'The Melting Point of Chloral Hydrate,' by C. G. L. Wolf. The conclusion is drawn that but one modification of chloral hydrate exists in the fused substance and that the observed differences in melting point are due to dissociation. 'The Relation of the Taste of Acid Salts to their Degree of Dissociation,' by Louis Kahlenberg. The author finds that the sour taste of solutions of acid salts is much stronger than would be accounted for by the theory that acid taste is due to free hydrogen ions. 'The Electro-Chemical Equivalent of Carbon,' by H. C. Pease. The value for carbon when anode in concentrated sulfuric acid has been already determined; the author finds the value in fused potassium hydroxid (that is in a Jaques' cell), to be three, as in the acid. Carbon in both these conditions is thus quadrivalent. In the February number: 'On the Emission and Absorption of Water Vapor by Colloidal Matter,' by P. Duhem, an extended mathematical treatment of the subject. 'The Melting-point of Formyl-phenyl-acetic ether,' by C. G. L. Wolf. 'Freezing-point Curve for Water containing Hydrochloric Acid and Phenol,' by J. A. Emery and F. K. Cameron. The depression of the freezing-point of water by hydrochloric acid and phenol is in general an additive effect. 'Note on Bunsen's Ice Calorimeter,' by J. W. Mellor; preparation of an air free water and filling the calorimeter therewith.

IN *The Osprey* for March, Paul Bartsch continues his 'Birds of the Road' discussing those seen in February and March about Washington. Eugene S. Rolfe describes 'Some Trials of a Field Collector' and J. P. Norris discourses of the 'Eggs of the Sandhill Crane.' Under the caption 'Biographies of Ornithologists' Theodore Gill contributes a first installment of a welcome sketch of Swainson. The editor promises other biographies and in commenting upon the mercantile value of eggs makes some interesting remarks on the 'impulse to collect something' that seems inborn in man.

The American Naturalist for March opens with a paper by P. Calvin Mensch 'On the Life History of *Autolytus Cornutus* and Alternate Generation in Annelids' in which the author reaches the conclusion that in *Autolytus* we do not have a sexual generation alternating with an asexual, but a sexual dimorphism. Frank R. Lillie presents 'Some Notes on Regeneration and Regulation in Planarians,' and W. W. Norman has some 'Remarks on the San Marcos Salamander, *Typhlomolge orathbuni* Stejneger' which include some excellent figures of this little salamander. C. F. W. McClure writes 'On the Frequency of Abnormalities in Connection with the Postcaval Vein and its Tributaries in the Domestic Cat (*Felis domestica*)' concluding that breeding experiments might give us some clue to their causes. J. A. Allen reviews 'The North American Jumping Mice' and L. Murbach treats of 'Fresh-Water Aquaria.' The Synopses of North American Invertebrates are continued by Harriet Richardson who discusses 'The Isopoda.' The balance of the number is devoted to numerous reviews of current literature.

THE plates for the April number of *Rhodora*, Journal of the New England Botanical Club, were destroyed in the recent fire at the Heintzemann press-rooms in Boston. The appearance of the April and May issues of *Rhodora* will necessarily be somewhat delayed.

SOCIETIES AND ACADEMIES.

NEW YORK ACADEMY OF SCIENCES.

SECTION OF ASTRONOMY AND PHYSICS.

A MEETING of the Section was held on Monday evening, February 5th. Professor J. K. Rees presented a report on November meteors. Arrangements were made by the Columbia University observatory to observe and photograph the meteors during the week of November 12 to 18, 1899. At West Point, Dr. S. A. Mitchell, assisted by Messrs. Bauer and Jenkins, was provided with a Rowland concave grating and two cameras. No photographs however were obtained. At Bayport, L. I., Mr. C. A. Post had placed his observatory and his services at the disposal of the Columbia observatory staff. Six cameras and two telescopes were made use of. On one plate in a camera provided with a Goerz lens, a photograph taken on November 15th, between 16 h. 9 m. 30 sec., and 16 h. 40 m. 44 sec., when pointed near Procyon, showed a meteor trail. Dr. Elkins of the Yale observatory will measure this plate.

A number of students and others watched for the meteors for the purpose of counting them, at West Point, New York, and Bayport. At West Point, in about four hours on November 15th, 17 meteors were seen of which 12 were Leonids. In New York on the same evening, three observers counted 68 in about 5 hours. Two other observers counted 36 in 2½ hours. At Bayport, two observers counted 39 in about 3½ hours.

Professor Rees, observing casually while attending to the photographic apparatus at Bayport, observed a first magnitude Leonid at 15 h. 29 m., on November 15th, between the two lowest stars in the handle of the Dipper. At 15 h. 39 m., he observed another first magnitude Leonid under Sirius. At 17 h. 15.5 m. a fine Leonid trail, lasting 3 seconds, was seen over Procyon. At 17 h. 30 m. a very bright Geminid was seen 20° south of Regulus.

Professor Rees also presented a paper on the variation of latitude, and the constant of aberration of light, as determined from six and one-half year's observations made at the Columbia University latitude observatory. Observations of latitude were made at the new site of Columbia University from April 24, 1893, to the present time, and will be continued until May 1, 1900. The observers were Professors Rees and Jacoby, and Dr. H. S. Davis. A zenith telescope made by Waunscaff of Berlin, was employed throughout. Its aperture is 80 mm., and its focal length is one meter. Four groups of stars were used, having mean right ascensions of about 6 h., 14 h., 18 h., and 22 h. respectively. Each group contained seven stars. Up to the present time, 6518 pairs have been observed on 758 nights. From the observations, a curve was drawn showing the latitude. This was compared with the curve required by Dr. S. C. Chandler's formula (*Ast. Jour.*, No. 446). From 1896, the observed epochs of maxima and minima seem to follow the computed in time.

These observations give for the constant of aberration of light the value

$$20''.464 \pm 0''.006.$$

Mr. George H. Bauer read a paper on the parallax of μ Cassiopeiæ and the positions of 56 neighboring stars, as deduced from the Rutherfurd photographic measures. This star has a large proper notion, and measurements of its parallax have been made by various methods and observers. The present determination is based on 28 Rutherfurd photographic plates, and the method of position angle was used in measuring them, as Professor Jacoby has already made a reduction using the method of distance. Eleven independent determinations were made giving a value of

$$0''.238 \pm 0''.014.$$

Professor Jacoby found by the method of distance $0''.275 \pm 0''.024$. These results agree even better than might have been expected. In forming the catalogue of 56 stars about μ Cassiopeiæ, the usual corrections for refraction, precession, nutation, aberration, proper motion, etc., were applied. Since the co-ordinates were measured in distance and position angle, these were then converted into difference of right

ascension and declination. After finding the positions for the epoch 1872.0, the precession and secular variation were computed and tabulated.

WILLIAM S. DAY,
Secretary of Section.

SECTION OF GEOLOGY AND MINERALOGY.

AT the meeting on March 19, 1900, Mr. G. F. Kunz presided, and forty-nine persons were present.

The secretary announced that this section and the Biological section had been requested to nominate candidates before April 20th, for the grant of the Newberry Research Fund, the grant this year being restricted to those working in botany and geology. Authority was granted to the chairman and secretary of the section to make such nominations to the council.

The chairman announced the course of lectures on 'The Principles of Geology' to be delivered at Johns Hopkins University in April, under the G. H. Williams memorial lectureship, by Professor W. C. Brõgger, of Christiania; also the receipt of the program of the International Geological Congress, at which the Academy would be represented by Professor J. J. Stevenson.

The chair announced the death of Doctor Oliver P. Hubbard, one of the earliest members of the Academy. On motion of Professor R. E. Dodge, a committee of three was appointed to draft resolutions on the death of Dr. Hubbard, and the chair appointed Dr. Julien and Professor Stevenson such a committee.

Professor Stevenson presented the following minute upon the life of Dr. H. B. Geinitz, whose death was announced at the February meeting.

Professor Dr. Hans Bruno Geinitz, for many years an honorary member of this Academy, died January 28, 1900, in the 86th year of his age.

His work as a geologist began very early, for in 1837, when only twenty years old, he published a paper on the 'Muschelkalk.' From that time until within a few weeks of his death brief notices, memoirs and volumes appeared in rapid succession. There seemed to have been no limit to his capacity for hard work. He studied the Cretaceous, Triassic and Carboniferous in detail, and his works on the coal fields of Saxony and Germany were marvels, when published, almost half a century ago. His papers on paleontology, vertebrate and invertebrate, and paleobotany are numerous and important.

He was put in charge of the Royal Mineralogical Cabinet at Dresden in 1846 and retained the position until 1898. The collections increased rapidly, so that, in 1857, the Royal Cabinet became the Royal Museum which in later years was one of the chief attractions for foreign visitors. In addition to his other labors, he was professor of mineralogy in the Royal Polytechnic school of Dresden from 1850 to 1896, serving meanwhile upon numerous government commissions.

Professor Geinitz was a typical student, caring little for things of this world, devoted to geology and his family. He was genial, sincere, a tender father, a generous friend. By his death German science has lost one of its most conscientious workers and Saxony one of its most respected citizens.

Dr. Alexis A. Julien and Dr. Theodore G. White were unanimously elected chairman and secretary, respectively, of the section for the ensuing year.

Dr. Henry B. Kümmel, Assistant State Geologist of New Jersey, read a summary of the information thus far collected in regard to the geology of 'The Palisades' of the Hudson river, illustrated by numerous views, many of them taken by Mr. Prince, of Orange, N. J. Most of the details of the paper will be found in the 1897 Report of the State Geologist of New Jersey. Observers are nearly all agreed that the Palisades are an intrusive trap sheet which has cooled at great depths. The basal contact is observable at 19 localities, in 15 of which the trap is unconformable upon the sandstone and shales beneath, and is penetrated by tongues of the latter, and in three is apparently conformable. The altitude of the lower contact increases from the south to the north, where it reaches 200 feet elevation. The upper contact is seen in six localities. At three of these, dikes penetrating the overlying shales occurred at the contacts, in two the contact is unconformable and in one conformable. In every instance the

beds superjacent to the trap are metamorphosed. In no locality of the Palisade range proper does the upper contact of the trap show any of the characteristics of surface cooling. Well-borings at Fort Lee penetrate 875 feet of trap, and the total thickness probably exceeds 950 feet, much erosion having taken place. Subsequent to deposition of the underlying sandstones the area was tilted, and the sandstone wasted away by erosion of many streams, the vacant channels of which are still present. The largest of these stream gaps was one and a half miles wide and is just north of the New Jersey state boundary. The cutting of gaps throughout the dissected tilted peneplane which remains was very uniform and indicates that the former land level was 220 feet lower than the present. If this is the case we have an instance of rivers beheaded close to their mouths. In addition to the wild beauty of the Palisades escarpment, the timber of this tract is the most luxurious and valuable of the State of New Jersey, although its area is much less than that of the pine groves of the south.

Professor John C. Smock, State Geologist of New Jersey, followed with an account of the efforts expended 'On the protection of the Palisades' from devastation by quarrymen. Legislative prohibition of such destruction is retarded by (1) lack of interest in the matter on the part of residents of southern New Jersey, (2) prospects of the future commercial value of the riparian lands at the base of the cliffs for purposes of shipping and manufacturing, which the removal of a portion of the cliffs would render available, (3) the present value to the state of its quarrying interests along the water front, (4) the income derived from riparian grants of these lands from the state to the quarrymen, which is devoted to the maintenance of the public schools, the approximate value to the State for this purpose of the lands from Fort Lee to the State border being about one million dollars. This clash between the interests of the schools and the preservation of beautiful scenery is the most serious obstacle with which legislation against defacing the Palisades has to contend.

In the face of these obstacles it is evident that the wholesale absorption of this territory for a purely sentimental object is impossible. The opposition to such a scheme could only be broken by years of fighting, and in the meanwhile the destruction of the cliffs and wooded slopes would continue with ever-increasing extent.

As a compromise Professor Smock proposed that an interstate commission of New Jersey and New York lay out a driveway along the base of the Palisades, quarrying, manufacturing, and shipping interests to be confined to the water side of the driveway, and the cliff side to be permanently preserved intact after the drive is completed. Edinburgh, Quebec and Sterling were cited as exhibiting rocky heights whose grandeur was enhanced by the fringe of manufacturies at their base, such buildings lending a basis to the eye by which to measure the proportions of the cliffs. Cliff defacement is also in progress upon the New York Palisades, where are the grandest wooded slopes and highest peaks. There is no need of encroachment on the cliffs, in either State, for there are many other places where as good material exists in equally great quantities and can be mined at practically the same expense.

Whatever is done should be done at once, or else we shall have lost a great part of the scenery which we wish to preserve. Steps should be taken to turn into a vast park as much of the territory as it is practicable to preserve, without destroying or coming in contact with the large public and private business interests that are involved.

In discussion Mr. Kunz voiced the sentiment that the opposition to legislation arose more with the officials at Trenton, than with residents of southern New Jersey, and felt that smoke and other nuisances from factory settlements along the cliff would be seriously detrimental. Were a restricted park created the value of residential property would in a few years benefit the State many times over the value of the riparian grants. Railroad tunnels might be permitted at distances of a few miles apart, with commercial villages at their waterfront terminals. The stone from such tunnels would defray the cost of quarrying.

Dr. Levison suggested that the removal of portions of the tailus would increase the ap-

parent height of the cliffs, if blasting of the latter could be prevented.

Professor Dodge described the similar trap formations of Connecticut.

After a vote of thanks to both lecturers the meeting adjourned.

THEODORE G. WHITE,
Secretary of Section.

DISCUSSION AND CORRESPONDENCE.

THE PLUMAGES AND MOULTS OF THE INDIGO BUNTING (*Passerina cyanea*).

IT is no new idea that the Indigo Bunting changes color without moulting, but just as one swallow does not make a summer, neither does one bird make 'aptosochromatism' an assured fact. This, however, is what a recent writer (Birtwell, SCIENCE, N. S., Vol. XI., Feb. 23, 1900) would have us believe, and yet there is quite a different way of looking at his supposed facts which suffer from the very 'individual error and dogmatism' he deprecates in others. He says "It is a singular fact that certain individuals have conceived the idea that a feather once having passed its premature condition (what may this be, please?) is utterly disconnected with the vital system of the bird and such individuals cling to this belief with a tenacity wonderful to behold." Doubtless it does seem 'wonderful' to persons who would wave aside all the careful observations that have been made upon feather growth and feather wear, and plumage generally, but possibly it is not so wonderful as the strange things they see just as soon as they watch a bird of striking colors in a cage. It is well to understand some elementary and fundamental facts that are self evident before having recourse to theoretical explanations, and lest Mr. Birtwell's conclusions be taken too seriously, it is my present purpose to first explain the plumage changes which regularly occur in the wild Indigo Buntings and then show why observations upon caged ones are open to doubt.

The Indigo Bunting regularly moults twice every year, differing in no wise in this respect from many other species, and like some of them it is also peculiar in requiring several moults to reach the adult plumage. This is what usually takes place in highly-colored species, and another peculiarity, if such it may be called, is the retention at the time of one moult of the feathers of certain areas until a later period of moult, a mixture of older and newer feathers in juxtaposition being the result. The key to the whole matter lies in understanding the principle of *sequence of plumages* as I have called it (*Auk.*, XVI., 1899, pp. 218–220, pl. III. and XVII., 1900, pp. 34–43) which is adequate to explain all parti-colored plumages without recourse to theory. I regret, that owing to unfortunate delays another article which explains the principle and its application at more length is still in press, so that it is not at present available for reference.

To understand clearly the successive stages of plumage in the Indigo Bunting it is desirable to take them up in the order in which they occur.

Natal Down. — On hatching, the chick is sparingly clothed with long downy filaments, the precursors of the definitive feathers to the apices of which they are attached. The down varies very little among the many species of Passerine birds.

Juvenal Plumage.—This second stage succeeds to the downy, part of the feathers being acquired before the bird leaves the nest. Brown is the prevailing color, paler below with streaks most obvious on the breast. In females the remiges and rectrices are wholly brown also, but in males they usually have a greenish blue tint most marked in the tail and varying in intensity according to the individual. The body feathers are looser in texture than are those of the next stage, assumed by the postjuvenal moult which occurs in the latitude of New York during August and September.

First Winter Plumage.—The third stage of plumage, commonly known as the 'autumnal,' is similar to the previous one, the moult usually involving only the body feathers. In males, the feathers of the throat especially become basally more or less tinged with dull blue, the females remaining dull brown and gray. Some males, however, assume by a more complete moult a new tail and several, usually, five or six, distal primaries which are nearly black and distinctly edged with bright blue. Indisputable

proof of moult in the shape of such feathers still in their sheaths, is furnished by a couple of birds in the collection of Mr. Wm. Palmer (No. 3283, September 17th and No. 3655, October 2d, Washington, D. C.). I am of opinion that it is perhaps only southern breeding birds that moult so completely at this season, for no northern specimens show it. Immature birds from semi-tropical localities taken during the winter months have either brown edgings or blue edgings to the remiges and rectrices and should not be mistaken for adults which have dark, blue-edged primary coverts, instead of the wholly brown ones which are characteristic of the young bird. It is probable that young birds, when they acquire precociously new wings and tail at the postjuvenal moult, like adults, do not again moult then until the following autumn; but we do know that most brown winged birds acquire five or six distal primaries, a new tail and body feathers besides at a prenuptial moult. Two birds in the New York National Museum (Nos. 107844–45 Bahamas, W. I., March 11th) prove actual growth of all these feathers, the worn brown primary coverts being retained and many summer specimens furnish evidence of having passed through a moult before reaching their breeding grounds, the relative amount of wear the different feathers show proving them to be of different ages. Very little is known about the prenuptial moult in most species and it appears to be in many of them a somewhat irregular affair spread over a number of the winter months, but there is ample evidence of its occurrence, the time, however, being the only puzzling feature.

First Nuptial Plumage.—The fourth stage of plumage in the Indigo Bunting results from the prenuptial moult which, as in most young birds, is more or less incomplete. Consequently we find breeding males almost wholly bright blue or with only a scattering of blue feathers mixed with the brown, gray or dull blue worn ones belonging to the first winter plumage. The individual variation is great, but all young birds may be differentiated by the ragged brown primary coverts. Females undergo very little moult and often none.

Second or Adult Winter Plumage.—In August, after the breeding season and relatively earlier than the time of the postjuvenal moult, the first postnuptial moult takes place. At this time all feathers are renewed in both sexes and the identity of young and old is lost in most cases, the former now acquiring for the first time blue-edged primary coverts like those of the latter. It is probable that a few year-old birds do not assume primaries and coverts as deeply blue as older birds, for in some winter specimens these are dull, but the majority do, as proved by birds taken in the midst of the moult. Specimens of adults in winter or 'autumnal' plumage, as it is commonly called, are scarce in collections chiefly because the adults migrate southward as soon as the moult is completed. The remiges, their coverts and the rectrices now acquired are, unlike those of the juvenal stage, worn for a twelvemonth; the body feathers, largely blue with rusty-brown tips which conceal much of the blue, are, on the other hand, like those of the juvenal stage, renewed by a prenuptial moult, the second. I have examined birds in the U. S. National Museum, and in the American Museum of Natural History, taken in Mexico, Yucatan and elsewhere which show new growing blue feathers at various points on the body, such specimens bearing dates of February and March. It is of interest to note in passing that the bright blue feathers assumed either in young or old show a different structure from those of the winter plumage when examined under the microscope and cannot be mistaken for them. The barbs are much more lanceolate than those of the winter dress.

Second or Adult Nuptial Plumage.—As just indicated the adult breeding dress is acquired by a partial moult which does not include the wings nor the tail which are renewed in the young bird. Before the prenuptial moult takes place the blue of the body feathers is exposed more or less by the wearing away of the feather tips, and birds often appear brighter than they do in the fall, but the moult itself is more complete upon the body than in young birds and fewer old worn feathers will be found upon adult summer specimens.

It is not necessary to trace the moults and plumages further for later ones are but repetitions of those already explained, and the few birds which show immaturity during their sec-

ond breeding season are certain to acquire fully adult colors at the second postnuptial moult, if they failed to do so at the first.

Here then we have the facts about the Indigo Bunting, and any specimen taken at the proper time of year will verify them. Nevertheless, Mr. Birtwell thinks that "for good results in investigations upon color change one should operate rather upon live birds in confinement." Well, perhaps so, for the 'proof' of color change without moult certainly does rest chiefly upon caged birds. The fact that they moult irregularly and often at long intervals and, as for instance in the case of the Purple Finch (*Carpodacus purpureus*), having once lost their bright colors may never again regain them does not seem to impair belief in a theory fifty years and more old. It began when most people were ignorant of the fact that birds could and did moult twice in the year. This was sagely declared to be too great a drain upon their vitality, but when it was found that some species did moult twice, theory had to be reserved for others that did not appear to be guilty of draining their vitality. When these in turn were proved to moult twice, refuge was taken in the assumption that only certain individuals of certain species changed color without moult. Later came red-handed proof of guilt in feathers found growing upon these individuals and the believers in theory fell back upon the claim that although one feather did seem to be renewed by moult, the one next to it underwent a color change, concerning the nature of which no two believers were agreed. Some of them have gone so far as to assert rejuvenation of frayed feather edges by some sort of exudative processes which only need to be carried a step farther to elimate altogether the necessity of moult. This is no fancy picture and I only paint it that my readers may know what 'aptosochromatism' represents.

Now, Mr. Birtwell comes forward with evidence convincing him of the growth of new feathers which expand of the wrong color and then undergo a change to blue, at the same time that the balance of old feathers also change. He kept an Indigo Bunting in a cage and, wiser than his predecessors, who have seen caged birds change color without loss of a feather, placed a 'fender' about it, resulting in the capture of over 1300 cast-off or moulted feathers! He tells us that the change to the blue in the new dull feathers had progressed 'excellently' when the bird died so that to this event he evidently attaches no importance. I do, and my opinion is that the dull feathers were deficient in color as is frequently the case in caged birds and never would have changed to blue had the bird lived. The blue he saw was either exposed by the wearing away of old feathers originally blue, or it belonged to new feathers the growth of which he failed to observe until the feather sheaths were lost. It is extremely easy to overlook growing body feathers which may be small and take but a few days to develop. The temptation is to make actual examinations of a struggling bird at long intervals and see the rest of the changes we want to through the bars of the cage, and I speak from experience with several birds. An adult male Indigo Bunting that I kept through the winter and up to July lost practically no feathers and yet members of my household were confident he was changing to blue and so he was by imperceptible loss of feather edgings. His cage was in a bag of mosquito netting such as I would commend to observers who cannot find feathers while a bird 'changes color.'

Now, of course, all the theorizing and microscopic evidence offered in Mr. Birtwell's article is not of the slightest importance if his bird did not do exactly what he claims it did, and I have already indicated some of the possible sources of error in observation. An observer who did not know the plumage differences between the adult and the young bird, nor discover the structural differences between autumnal and nuptial feathers, nor hesitate to look for 'carrier pigment cells' under the microscope, may well have his accuracy of observation questioned. These are some of the things that do not tend to inspire us with confidence in Mr. Birtwell's well-meaning and painstaking article for the narrowness of his horizon prevents facts being seen in their true light. It is so easy to be mistaken, and a mountain of theory resting upon a tiny and insecure base of alleged fact has ere now brought the *Chromatist* to grief. When the well-established laws of feather growth and

feather loss fail to account for plumages, it will be time enough to adopt theories demanding new life in epidermal structures, that for many months have been histologically dead. The existence of such a thing as 'aptosochromatism' will hardly be proved by those who have no grasp upon fundamental principles, and as long as such observers expect to be taken seriously, they must not be surprised if they are called sharply to account.

Jonathan Dwight, Jr.

New York.

INDIAN PICTOGRAPHS ON THE DAKOTA SANDSTONE.

The Dakota cretaceous formation which extends from northeastern Nebraska to southwestern Kansas is composed of massive ledges of sandstone alternating with beds of shale and clay. These ledges weather out and in many places form precipitous walls from ten to fifty feet high.

It is upon these walls that the Indians have written their history in pictographs. Traces of the drawings may be seen on dozens of cliffs in the two states. Old hunters and cattlemen tell us that twenty years ago or more the chalk cliffs of the Niobrara cretaceous in western Kansas were also covered with these inscriptions. But they have already disappeared because of the soft material composing the wall upon which they were carved. The Dakota sandstone being somewhat harder is consequently not so easily worn away and many of the drawings are still legible.

Not infrequently the sandstone wall in the immediate vicinity of one of the springs which abound in the Dakota will be covered with these hieroglyphics. This is the case at the Santee caves on the Platte river opposite Ashland, Nebraska, and at the noted cave section in Ellsworth county, Kansas. Again some prominent cliff or land-mark has evidently been selected. Pawnee rock on the old Santa Fé trail, the spot forever wedded to a tale of terror, was formerly covered with pictographs. The face of the rock has since been blasted away for building stone. A cliff of yellow sandstone standing boldly out on the north bank of the Smoky Hill river near the mouth of Alum creek contains some of the finest pictographs in the region.

In 1867 Dr. F. V. Hayden, United States Geologist described some pictographs near the Blackbird mission on the Missouri river some twenty miles south of Sioux City, Ia., as follows:

"About two miles above the mission the hills are cut by the river so as to reveal vertical bluffs, the rocks of which in the distance have a yellowish-white appearance and from this fact are usually called chalk bluffs. * * * This is perhaps the finest and largest exposure of the rocks of this group along the river. The mural exposures of soft sandstone present good surfaces for the Indian to make use of on which to write his rude history. And on the chalk bluffs there are many of these hieroglyphics in positions totally inaccessible to the Indian of the present time. None of them now living know anything about them and it is supposed that they must be very ancient, and that, since they were made, great changes must have been made in these bluffs by the waters of the Missouri. These markings are at least fifty feet above the water and fifty feet or more below the summit of the bluff, so that they must have been made before the lower portion of the bluff was washed away by the Missouri. It seems strange that none of these hieroglyphic writings which occur quite often on the chalk-rocks of the Niobrara group higher up the Missouri are known to any Indians now living. The creek near by is called in Dakota language the creek where the dead have worked on accounts of the markings on the rocks."

The pictographs referred to by Dr. Hayden may still be seen, although many of them are now practically obliterated.

Not infrequently these inscriptions occur in obscure cañons or lonely cliffs. The sandstone was easily scratched and the artist was evidently not seeking notoriety. Examples may be cited in a cañon five miles east of Kanapolis and in Cameron's draw near Belvidere, Kansas.

The writer has neither the ability nor inclination to discuss these picture writings from an ethnological standpoint. Doubtless the figures had a meaning, not only to those who drew them, but also to their contemporaries. Such writings are found in many, perhaps all parts

of the country. Human figures, horses, weapons, birds and symbols are the most common forms represented. In one place a man is seen leading seven ponies. Again the gigantic figure of a man about fifteen feet in length is reclining. Spears, shields, eagles, turtles, men on foot and horseback are scattered over the surface of the rocks in apparently endless confusion.

The soft sandstone is rapidly weathering away. In many places only mere outlines of the figures remain. Often the entire face of the cliff will fall off. It is but a question of a few years when the last trace of the figures will be gone. But more destructive than the ravages of time is the vandalism of man. It would seem that every white man who has visited these localities has felt it incumbent upon him to scratch his own name on the rock. This of itself might be considered only an exhibition of poor taste, were it not for the fact that he has almost invariably chosen to carve his own plebeian name over a pictograph. And with characteristic American thoroughness the scrawling letters are so broad and deep that the older figure is usually obliterated. Thus it is that many of the best examples of Indian picture writing have been and are being destroyed. Unfortunately there seems to be no way to prevent this vandalism. In a few years these records of a forgotten people shall have disappeared.

CHARLES NEWTON GOULD.
UNIVERSITY OF NEBRASKA,
February 10, 1900.

SYSTEMATIC ARRANGEMENT OF ORE DEPOSITS ON A GEOLOGICAL BASIS.

THERE has been, of late years, a growing tendency to consider ore deposits from a geological standpoint. Heretofore it has been the general custom to almost ignore the physical character and structure of the rock formations with which given ore bodies are associated.

As some sort of comparison must be necessarily made between ore bodies as they are developed, their classification crude though it is, begins to take place early in their consideration. With the ordinary miner such a scheme is strictly empirical, according to some obvious features presented. From this to a scientific plan the step is a long one.

Why the classification of ore bodies has remained so long in an unsatisfactory state, and little or no real progress made, while other related branches of knowledge have advanced with gigantic strides, finds its chief explanation in the fact that our methods of investigating the phenomena connected with the alteration of rocks generally were inadequate. Until the beginning of the last quarter of our century these methods were advanced but little beyond what they were a hundred years before. The activity in natural science studies was in other directions.

With the application of the microscope to the rocks and the opening of a new world to the geologist as vast and as interesting as that which the same magnifying glass gave to the biologist, rock metamorphism assumed a new rôle. Ore formation is found to be merely a special phase of general rock alteration. It goes on under the same conditions and by the workings of the same geological processes.

The study of ore genesis and relationships of ore bodies has become a strictly geological proposition. The recent investigation of the ores from the standpoint of geology appears to be capable of producing good results. It is replete with suggestive inference. With modern geology as a foundation the near future cannot but open up to us unheard of and unthought of advantages in the practical development of the ores. We stand on the threshold of a new era.

On this topic we get a glimpse of the general trend of modern thought respecting the genesis of ore deposits by reference to the principles, formulated by Prof. C. R. Van Hise in his treatise on the general metamorphism of rocks (not yet published), as adapted recently to ore deposits. This summary is contained in his paper on 'Some Principles controlling the Deposition of Ores,' read at the Washington meeting of the American Institute of Mining Engineers.

So far as the classification of ore deposits is concerned we appear safe in concluding that:

(1) The chief feature wherein the classificatory scheme hereafter presented differs from others, is in the prominence given to geological occurrence and the direct operation of the geological processes as essential factors in the genesis of the ore bodies.

(2) The nearest possible approach to a purely genetic classification of ore deposits is believed to be found in their geological relationships, as determined by the great geological processes and not in their direct chemical formation, or physical shapes.

(3) The chemical reactions so widely used as criteria of ore classification are to be regarded as general agencies and therefore they are not available in the specific determinations of the various groups of ore bodies.

(4) In the discovery and exploitation of ores, structure is of first importance; not so much the structure of the individual ore body itself as the geological structure of the enclosing country rocks.

(5) The primary groupings of ore bodies appear to be best indicated when based upon their geological occurrence, as governed by the nature of geological processes operating.

(6) The secondary groupings appear to be best based upon the general form of the ore-bodies as geological formations produced by the grander categories of geological agencies.

(7) The ternary groupings are best based upon the specific phases of the geological processes involved in the formation of ores as ore bodies.

(8) The source of the ore materials is an unessential factor in their classification; the great practical question is, how are ores best exploited? In this connection it matters little what was the original condition of the ores. Nor have we to do very much with the detailed, complex, and usually theoretical reactions that are supposed to take place before the final stage of the ore, as we find it, is reached.

(9) Very similarly appearing ore-bodies may be formed by very different methods, a fact which, while apparent in all classifications, does not necessarily vitiate any.

(10) The present scheme is merely suggestive. It is the barest outline of what is believed to be capable of much further expansion and development into a comprehensive, rational and practical general plan.

Classification of Ore Deposits

Groups.	Categories.	Miners' Terms.
I. Hypotaxic (Mainly Surface Deposits.)	Aqueous transportation.	Placers, beds.
	Residual cumulation.	Pockets (in part), some breccias.
	Precipitative action.	Bog bodies, bedded veins, layers.
II. Eutaxic (Chiefly Stratified Deposits)	Emponded amassment.	Some masses, segregations (in part).
	Selective dissemination.	Impregnations (in part).
	Fold filling.	Saddle-reefs.
	Crevice accretion.	Gash veins, some stock-works
	Concretionary accumulation.	Nodules, some bands.
	Metamorphic replacement.	Fahlbands (in part).
III. Ataxic (Largely Unstratified Deposits.)	Magmatic secretion.	Masses (in part), some lenses
	Metamorphic segregation.	Stocks.
	Fumarole impregation.	Contact veins, some impregnations
	Preferential collection.	Chambers (in part), some pockets, linked veins.
	Shearing satiation.	Attrition veins, some disseminations.
	Fault occupation.	True veins, some linked veins, lodes.

Charles R. Keyes.

NOTES ON INORGANIC CHEMISTRY.

The work of H. Brereton Baker on extremely dry gases is continued by a paper on the vapor densities of dried mercurous chlorid and dried mercury, read before the Chemical Society (London). It is found that perfectly dry mercurous chlorid at 443° in an atmosphere of nitrogen shows a density of 217.4 which corresponds to the formula Hg_2Cl_2. The undried substance gives a deeper density of 118.4° showing that the dissociation of mercurous chlorid like that of ammonium chlorid is dependent on the presence of water vapor. The density of dry mercury on the other hand was found to be 108.1 at 448° showing that at this temperature the molecule of mercury is monatomic.

The same evening two papers were read by A. Scott, one on the preparation of pure hydrobromic acid in which the employment of sulfurous acid is recommended in the place of amorphous phosphorus. It is very difficult to free the phosphorus completely from chlorin, and arsenic is almost always present, which gives rise to arsenious bromid in the hydrobromic acid and arsenites and arsenates in the bromids made from this acid. When sulfurous acid is used, the hydrobromic acid is easily freed from the sulfuric acid formed by two or three distillations, the last over barium bromid.

THE second paper by Mr. Scott was on a new sulfid of arsenic, which is obtained in the process of purifying phosphoric acid from the small quantity of arsenic derived from the impurity in the phosphorus used. The new sulfid has the formula As_3S, and unlike the other sulfids of arsenic is insoluble in ammonia and ammonium sulfid, but is soluble in ammonium polysulfid, and is decomposed by caustic potash.

IN the last *Berichte* of the German Chemical Society, L. Vanino and O. Hauser call attention to an interesting reaction of lead peroxid. When it is exposed in a dry or even moist condition to a current of hydrogen sulfid, it glows brightly and the hydrogen sulfid burns with the blue flame of lead. The reaction is not only suitable for a lecture experiment on its own account, but it may be utilized for the ignition of explosive mixtures. Wet gun cotton is instantly exploded, and so are picrate powders, powdered metals such as aluminium, zinc and bismuth burn with brilliancy. Silver and bismuth peroxids act in a similar manner to lead peroxid, cobalt and copper peroxids become much heated in hydrogen sulfid, but do not ignite it, while red lead, pyrolusite, and freshly precipitated peroxid of manganese do not show the reaction.

IT has lately been discovered by Moissan that metallic calcium is soluble in liquid sodium. On cooling the calcium separates out in brilliant white hexagonal crystals of the pure metal. The mass of sodium and calcium is put in absolute alcohol at 0° when the sodium is gradually dissolved out and the crystals of calcium remain. The metallic calcium is obtained by the action of metallic sodium on calcium iodid and the whole process carried out in a closed iron crucible in one operation. Crystals of calcium may also be obtained by electrolyzing fused calcium iodid at a low red heat.

A PAPER has recently appeared in the *Bulletin* of the French Chemical Society, by A. Gautier, on the normal occurrence of arsenic in animals, including man. It appears to be always present in the thyroid gland, in lesser quantities in the thymus and the brain, while traces are always present in the skin and hair. It does not appear to be in any other organs of the body, and consequently would play little part in the toxicology of arsenic, as these organs are rarely used for the detection of arsenic; the brain, however, is sometimes examined. The arsenic appears to be in the form of nucleins.

J. L. H.

TOBACCO, TOBACCO-PIPES AND SMOKING.

PERHAPS the most American of all implements and practices, the above have been described and figured hundreds of times, but never in so scientific a spirit as by Joseph D. McGuire, the archæologist, residing in Ellicott City, Maryland. His monograph appears among the octavo publications or 'Reports' of the United States National Museum, Smithsonian Institution, under the title: 'Pipes and Smoking Customs of the American Aborigines, based on material in the United States Museum,' 1897, pp. 351–645, and last year also appeared as a separate volume. Numerous illustrations give us an idea of the richest and most curious finds of sundry tribes, partly of stone or wood, partly of terracotta and clay, a large number of them having been found in the mounds of the Ohio and Mississippi valleys. The shape of the bowls are of all descriptions; some represent birds, heads of birds, mice and other rodents, toads, frogs, lizards, men in a recumbent, sitting or squatting posture, human hands and faces, etc. The tubular shape was widely in use in ancient America, though it looks very inconvenient to us; Mr. McGuire figures stone tubes with bone mouthpiece, sandstone tubes, pottery tube pipes, red pottery tube and bowl pipes, steatite tubular pipes, cop-

per tubes, bone pipes and others. There are also stone urn-shaped bowls, stone bowls with thong holes, antler pipes, fossil pipes, various kinds of trade pipes, brazed iron pipes, tomahawk and monitor pipes. The feathered calumet pipe of the West looks artistic and attractive, and the vase-shaped Micmac pipe has at least the merit of curiosity.

The author has with consummate industry collected passages referring to pipes and smoking in the historians of past centuries and given his ideas about the formation of types in smoking implements. There are but few articles of Indian manufacture that will give a clearer idea of the artistic sense or genus in fashioning ruder material than pipes, although they all manifest that they originated in the stage of barbarism. Probably the oldest instance, historically traceable, is the richly dressed shaman or chief represented upon the Palenque tablet of Chiapas state, who makes use of a long tubular pipe to produce a huge cloud of smoke issuing at the wider end, and seems to enjoy the smoking intensely, to judge from his very characteristic grimaces. This bas-relief is reproduced in McGuire's publication; he thinks that the use of tobacco for snuffing was peculiar to South America, and the habit of chewing is but seldom and indistinctly referred to in any part of this western world.

A. S. G.

SCIENTIFIC NOTES AND NEWS.

The Prussian Budget, which has passed to a second reading, contains an appropriation of 7,300,000 Marks, for the purchase of lands in Berlin, on which is to be erected a building for the Academy of Sciences and the Royal Library. The value of the land is estimated at over 11,000,000 Marks, but about 3,000,000 Marks is obtained by the exchange of other property, and 1,000,000 Marks is to be appropriated next year.

At a meeting of the Royal Institution, London, on April 2d, it was announced that the managers had that day awarded the Actonial Prize of 100 guineas to Sir William Huggins, F.R.S., and Lady Huggins for their work 'An Atlas of Representative Stellar Spectra.' The special thanks of the members were returned to Mrs. West and Mrs. F. Colenso for their present of a portrait of their father, the late Sir Edward Franklin, F.R.S., professor of chemistry at the Royal Institution from 1863 to 1868.

Dr. Rudolph Amadeus Philippi the naturalist, professor in the University of Chili at Santiago, has celebrated the seventieth anniversary of his doctorate. Congratulatory addresses have been forwarded from the German Botanical Society and the Medical Faculty of the University of Berlin.

Dr. O. Burger, titular professor of the University of Göttingen, has been appointed director of the zoological division of the National Museum at Santiago and professor in the university.

Mr. John C. Hammond has been appointed assistant in the *Nautical Almanac* office, connected with the United States Naval Observatory, Washington, D. C.

Dr. William P. Wilson, director of the Philadelphia Commercial Museums, has gone to San Francisco to assist in the establishment of the Pacific Commercial Museum.

Professor Oscar Bolza, of the University of Chicago, has sailed from New York for Naples. He expects to be abroad for nine months pursuing mathematical investigations in a university town.

Professor F. Wohltmann, of Bonn, has been commissioned by the German government to proceed to Africa to make agricultural studies in the Cameroon District.

The Michigan Academy of Sciences held its annual meeting at Lansing, on March 29th and 30th. The president, Professor Jacob Reighard, gave an address on 'The Biological Sciences and the People.'

Professor Edward L. Nichols, of Cornell University, will deliver the first annual address to the honorary scientific society of Sigma Xi at Kansas University during the commencement week in June.

Professor John M. Coulter, who has recently returned to Chicago after a long stay in Washington, addressed the Botanical Club on April 10th on the present work of the Washington botanists.

Mr. M. A. Barber, associate professor of

botany in the University of Kansas, has sailed for Europe. He will spend the summer in special study in bacteriology at the University of Berlin, returning for the opening of the fall term.

THE following appointments have been made by the Irish Department of Agriculture and Technical Instruction: To be Superintendent of Statistics and Intelligence branch, Mr. W. P. Coyne, M.A., Fellow of the Royal University of Ireland, professor of political economy and jurisprudence, University College, Dublin, barrister-at-law. To be Inspector in Agriculture, Mr. James Scott Gordon, B.Sc., Department of Agriculture, Edinburgh University, principal of the Cheshire County Co uncil Agricultural and Horticultural School. To be Inspector in Industrial Branch, Mr. W. T. M'Cartney Filgate.

MR. ROGERS FIELD, an English hydraulic and drainage engineer, died at Hampstead on March 28th, at the age of 69 years. He was the inventor of an improvement in the aneroid barometer, but was best known for his improvements in methods of sanitary engineering.

M. SAMSON JORDAN, a distinguished French engineer and metallurgist, has died at the age of sixty-nine years. He had been since 1865, professor of metallurgy in the École des Arts et Manufactures. He in numerous ways promoted the advancement of the iron and steel industries in France and was the author of several valuable metallurgical treatises.

WE find in the *Auk* notices of the deaths of several members of the Ornithologists' Union. Mr. George P. Sennet died at his home at Youngstown, O., on March 18th at the age of 59 years. Though in active business he made valuable studies on the birds of Texas and the adjacent territory and his fine collection is at present in the American Museum of Natural History. W. E. Brooks has died at Mount Forest, Ontario, at the age of 70 years. He was an authority on the birds of India and his large collection is now in the British Museum. He wrote especially on the smaller warblers and the raptores. Mr. Francis C. Brown has died at Framingham, Mass., in his 70th year. In early life he was associated with Agassiz and other naturalists and made valuable observations on the habits of birds. John A. Dakin has died at Syracuse, N. Y., in his 48th year. He was a student of birds and butterflies. Mr. Foster H. Brackett died at Dorchester, Mass., aged 87 years. He had contributed notes on birds to the *Auk*.

A TELEGRAM has been received at the Harvard College Observatory from Professor Kreutz, at Kiel, stating that he has information from Professor Backlund, Director of the Observatory at Pulkowa, Russia, that from a discussion of spectrograms, Belopolsky has found the time of rotation of Venus to be short.

WE note in a recent article by Dr. K. Kishinouye, in the *Revue Internationale de Pêche et de Pisciculture* (the new Russian journal), that a Japanese marine zoological station was opened during the past summer, on the coast of the Inland sea. It is for the present located in a two-story house at Omomichi. We note also in the same article that a large coral reef has been recently discovered near the southern end of Kiu-Shiu. Its size must be a large one, for more than sixty boats are fishing it actively.

STATE bacteriological institutes are being established in various parts of Russia. Among those recently founded are one at Vladivostock in Eastern Asia, and one in Merv, in Central Asia. The latter is of special importance because many epidemic diseases are thought to have their origin in Central Asia.

THE Maryland Legislature has made the following appropriations for the scientific work of the Maryland Geological Survey and the Maryland Weather service for the next two years:

Maryland Geological Survey, Geological Division, $10,000 annually.

Maryland Geological Survey, Highway Division, $10,000 annually.

Maryland Geological Survey, Topographic Division, $5,000 annually.

Maryland Weather Service, $2,000 annually.

The Survey has recently commenced the investigation of the clay products of Maryland under Professor Heinrich Ries who will prepare a volume of reports upon the clay industry of Maryland, making such physical and chemical tests of the clays as may be required to show their possibilities in various directions.

By the will of the late John Halstead, Cooper Union, New York City, is made the residuary legatee of his estate, and will ultimately receive about $250,000.

Among the bills passed by the New York Legislature just before its adjournment was included an item "For the Pathological Institute, twenty thousand dollars, or so much thereof as may be necessary, no part of which shall be paid for rent." As the Pathological Institute is established in rented quarters in New York City, it is not obvious how it can continue its work without paying rent. The State commissioners in Lunacy, it is suggested, may have taken this method to stop the work of the Institute.

The seventh annual reception and exhibition of the New York Academy of Sciences will be held at the American Museum of Natural History on April 25th and 26th. On Wednesday evening, April 25th, there will be a reception to the members of the academy and their invited guests, while on the following day the exhibition will be open in the afternoon for students and others, and in the evening there will be a reception for the members of the Scientific Alliance. The committee in charge of the exhibition consists of Professor J. F. Kemp, chairman; Professor Henry F. Osborn, Mr. Charles F. Cox, Professor Charles A. Doremus, and Professor J. J. Stevenson. The exhibition is to be divided into a number of sections, each in charge of a chairman, who is responsible for the collection of exhibits. The various chairmen and their departments are as follows: Anthropology, Professor Franz Boas; astronomy, Professor J. K. Rees; botany, Professor D. T. MacDougal; chemistry, Professor Charles E. Pellew; electricity, George F. Lever; geology and geography, Professor R. E. Dodge; metallurgy, Professor Henry M. Howe; mineralogy, Dr. L. McI. Luqueer; paleontology, Gilbert Van Ingen; physics and photography, Professor William Hallock; psychology, Dr. Edward L. Thorndike; zoology, Professor Charles L. Bristol.

The eleventh session of the Biological Laboratory of the Brooklyn Institute of Arts and Sciences, located at Cold Spring Harbor, Long Island, will open on Wednesday, July 4th, and continue for six weeks. The following courses are announced: by Professor C. B. Davenport, of the University of Chicago, High School Zoology and Variation and Inheritance; by Dr. D. S. Johnson, of Johns Hopkins University, Cryptogamic Botany; by Professor C. P. Sigerfoos, University of Minnesota, Invertebrate and Vertebrate Embryology; by Professor H. S. Pratt, Haverford College, Comparative Anatomy; by Professor Nelson F. Davis, Bucknell University, Bacteriology; by Dr. H. C. Cowles, University of Chicago, Elements of Ecology and Ecological Seminar; Mrs. C. B. Davenport, Microscopic Methods; Dr. Henry A. Kelly, Ethical Culture Schools, New York City, Nature Study; Messrs. S. R. Williams, and W. L. Tower, of Harvard University, and W. C. Coker, of Johns Hopkins University, assist in the various courses. The different instructors offer to assist in investigation. The fee for a single course is $20, with $5 additional for an additonal course or for the use of a microscope. Board and rooms are furnished at $6 a week by the laboratory. Further information and the annual announcement may be obtained of Professor Franklin W. Hooper, 502 Fulton Street, Brooklyn, N. Y., or Dr. C. B. Davenport, University of Chicago, Chicago, Ill.

Mrs. Sara T. D. Robinson, widow of Governor Charles Robinson, has established a Kansas University woman's table for advanced work in botany, zoology, and physiology at the Marine Biological Laboratory at Woods Holl, Mass. Miss Alberta Cory, a graduate student of botany has received the first appointment.

There will be a U. S. Civil Service examination, on May 15th, for the position of statistical field agent in the service of the Fish Commission.

Secretary Gage has asked the House of Representatives to appropriate $200,000 additional to the fund of $300,000 to prevent the introduction and spread of epidemic diseases.

The Secretary of the Interior has been requested to inform the House of Representatives of the number of acres now included in the forest reserves belonging to land-grant railroads or other corporations at the time of the creation

of such forest reserves, also the amount of lieu scrip issued therefor; also what extensions of existing reserves are in contemplation, with the amount of railroad grants in proposed reserves or extensions, and the number of acres located by forest reserve scrip.

THE Cartwright lectures of the Alumni Association of the College of Physicians and Surgeons, Columbia University, for 1900, will be delivered at the New York Academy of Medicine, No. 17 West 43d Street, on the evenings of April 18, 24, and 26, 1900, at 8:30 o'clock, by Professor John G. Curtis, M.D., of Columbia University. His subject is 'The Discovery of the Nerves and of their Function.'

ARRANGEMENTS have been completed for the spring course of lectures, at the New York Botanical Garden, which will be given in the lecture hall of the Museum on Saturday afternoons at 4:30 o'clock, as follows:

April 14th, 'A Glimpse at the Kingdom of Plants,' by Dr. N. L. Britton.

April 21st, 'Spring Flowers,' by Mr. Cornelius Van Brunt.

April 28th, 'Ferns,' by Professor L. M. Underwood.

May 5th, 'Climbing Plants,' by Dr. D. T. MacDougal.

May 12th, 'Seeds and Seedlings,' by Professor Francis E. Lloyd.

May 19th, 'Summer Flowers,' by Mr. Cornelius Van Brunt.

May 26th, 'Some Tropical Relatives of the Potato,' by Professor Henry H. Rusby.

June 2d, 'The Fairy-lore of Flowers,' by Professor E. S. Burgess.

June 9th, 'Plants Concerned in the Formation of Coal,' by Dr. Arthur Hollick.

June 16th, 'Seaweeds,' by Dr. Carlton C. Curtis.

June 23d, 'The Flora of Alaska,' by Mr. Frederick V. Coville.

The lectures will be illustrated by charts, living material and lantern slides and will be non-technical. The museum building may be reached by a walk of three minutes from the Bedford Park Station of the Harlem division of the New York Central Railroad, and by a walk of five minutes from the Fordham trolley line, connecting directly with the Second and Third Avenue Elevated roads.

THE Department of Archæology and Paleontology of the University of Pennsylvania announces a course of free public lectures to be illustrated by objects in the museum, to be delivered in the Widener Lecture Hall of the Museum on Wednesday afternoons at 4 p. m. as follows:

April 4th, Professor Lightner Witmer, 'Present Day Survivals of Primitive Modes of Thought and Feeling.'

April 11th, Mr. Stewart Culin, 'The Origin of Ornament.'

April 18th, Dr. A. T. Clay, 'Recent Excavations in Babylonia.'

April 25th, Dr. William N. Bates, 'Coinage of the Ancient Greeks.'

May 2d, Professor Hugh A. Clarke, 'The Genesis of Musical Instruments.'

May 9th, Dr. Simon Flexner, 'Impressions of the Philippine Islands.'

May 16th, Professor John B. McMaster, 'Household Life of Women in the Colonial Period.'

WITH reference to M. Joseph Bertrand, whose death we announced last week, a correspondent of the London *Times* says: Born at Paris in 1823, he was early initiated by his father, who had been trained at the Polytechnic School, into mathematical studies. At 11 years of age he passed an examination for admission into that school, but this was merely an exploit, and he did not enter the establishment till the usual age of 17, when he headed the list of candidates. On leaving the Polytechnic, he became a mine inspector, next professor at a Paris college, and afterwards professor successively at the Polytechnic, the Normal School, and the Collège de France. In 1856 he succeeded Sturm in the Academy of Sciences, and in 1874 he took the place of Eli de Beaumont as one of its secretaries. In 1884 he became the successor of Jean Baptist Dumas in the French Academy. As a writer and debater he was singularly clear, sometimes with a vein of irony. Of late years he contributed biographical and critical articles on genuine or pseudo-mathematicians to the *Revue des Deux Mondes*. His more serious works include essays on Paschal, Lavoisier, d'Alembert, and Comte, and lectures on the calculation of chances, and on electricity. His son, M. Marcel Bertrand, a mining engineer, is likewise a member of the Academy of Sciences.

The Royal Meteorological Society celebrated its Jubilee on Tuesday and Wednesday, April 3rd and 4th. The *British Medical Journal* states that on Tuesday afternoon a meeting was held, when the President (Dr. C. Theodore Williams), addressed a large number of Fellows of the Society and delegates of other societies. He began by explaining that the late Mr. G. J. Symons, who had been elected President for the Jubilee year, had, before his fatal seizure of apoplexy, prepared an address tracing the beginning of meteorology in this country, and the history of the Society. Mr. Symons stated that the earliest observer was the Rev. William Merle, whose records, made at Driby, in Lincolnshire, from 1337 to 1344, were still preserved in the Bodleian Library. After referring to Robert Boyle and Dr. Plot, Mr. Symons pointed out that Sir Christopher Wren, the architect of St. Paul's was the inventor of the first recording rain gauge. An English Meteorological Society had been founded in 1823, but did little work. Another society was founded in 1836, but did not take any part in the formation of the present society, which was founded on April 3, 1850, at the house of the late Dr. Lee, F.R.S., of Aylesbury, under the name of the British Meteorological Society. In 1866 a Royal Charter was obtained, and the Society assumed its present name. Mr. Symons urged that the Government, which provided a home for some of the richer societies at Burlington House, ought to build a proper centre for the smaller societies, and his address concluded with a sketch of the work done by the Royal Meteorological Society. Dr. Theodore Williams, after a short appreciation of the character and work of the late Mr. Symons, gave account of the scientific work which is now being carried on by the Society. At the conclusion of Dr. Williams's remarks each of the delegates attending the meeting was presented with a medal struck in honor of the occasion. In the evening a *conversazione* was held, and on Wednesday morning a visit was paid to Greenwich Observatory. In the evening a dinner was held over which Dr. Theodore Williams presided. Mr. W. N. Shaw, the Secretary of the Meteorological Council, who gave the toast of 'The Royal Meteorological Society,' enumerated some of the phenomena which still awaited explanation and insisted on the necessity of co-operation, both among meteorologists themselves and between them and workers in other sciences. The toast having been suitably acknowledged by the President, Mr. Bayard gave that of 'The Delegates from other Societies,' for which Professor Silvanus Thompson responded.

Nature in commenting editorially on the discussion before the American Society of Naturalists, on 'The position that universities should take in regard to the investigation,' published in this Journal, compares unfavorably the work of English Universities with those in the United States and in Germany. The article concludes as follows: It is needless to say that, like the American universities, the universities of the continent, and in especial those of Germany, are conspicuous for the extent to which they encourage research by their funds and by their arrangements. The historian of the future, who is to trace the vast progress made in recent years by Germany in power, wealth, commerce, the arts and industries, without doubt will notice the part played by her many universities in this momentous change. A single article in the pages of a scientific journal is not a suitable vehicle for any exact examination of the relative advances made by England and other countries in recent times. But, until matters have been put right, every opportunity is convenient to insist that the universities of Britain do not encourage research sufficiently, and that, in particular, her richest university habitually and systematically despises research in its general arrangements, in the allocation of its endowments, and in the distribution of its revenues. Moreover, it is especially unfortunate that not only is the amount of consideration given to research minute, but is diminishing. A single example is more convincing than a multitude of general statements, and an appropriate instance lies unfortunately ready to hand in the preface to the last volume of 'Linacre Reports,' recently issued by Professor Ray Lankester. The late Linacre Professor and present keeper of the British Museum of Natural History, in a preface addressed to the vice-chancellor of the University of Oxford, deplores the attitude of the Oxford

colleges to the natural sciences. "The college endowments," he states, and every one with knowledge of the matter is able to corroborate, "are now more largely than ever employed in maintaining a tutorial system, which is in itself of small value—if not positively injurious—and necessarily in complete antagonism to the development of the method of study, and to the wide range of subjects studied, which distinguish everywhere but in Oxford the university from the preparatory school." Professor Lankester believes that the natural sciences, the subjects particularly associated with research as a means of training and as a source of directive knowledge, should be supported by not less than two-thirds of the endowments at the disposal of these colleges. Oxford, no doubt, is an extreme example of the general failure of British universities to respond adequately to what everywhere but in England is regarded as the first duty of a university; but there is urgent need for inquiry into and redress of the conditions which have brought about the present state of affairs, and those institutions which have taken a larger view of their duties will be the first to approve a strong statement of the existing failure.

UNIVERSITY AND EDUCATIONAL NEWS.

As the daily papers have announced, the University of Chicago has secured the $2,000,000 needed to meet the requirements of Mr. Rockefeller's gift of an equal amount. At the recent convocation of the University, President Harper gave some details in regard to the gifts received since January 1st. They have come from more than 200 different persons and 90 per cent. of them were unsolicited. The largest items appear to be the Gurley paleontological collection, $30,000 from Mrs. Delia Gallup and, given anonymously, $60,000 for a commons, $50,000 and $25,000 for a students' club-house, $20,000 towards a women's hall, and $30,000 with specific use to be designated later. President Harper stated that the total assets of the University are now not far from $11,000,000.

BY the will of Mrs. Mary J. Furman, Vanderbilt University receives about $250,000.

BARNARD COLLEGE, Columbia University, has received a gift of $100,000 subject to certain annuities.

BY the will of ths late Arthur D. McLellan, Brown University may, under certain conditions, receive from $8000 to $33,000.

THE widow of the late Professor H. Fol has given to the University of Lausanne his collection of scientific apparatus and histological preparations.

HARVARD UNIVERSITY has undertaken to guarantee $70,000 to entertain 1450 Cuban teachers during their stay at the Summer School in accordance with the arrangements made by Mr. Alexis E. Frye, Superintendent of Schools at Cuba. Free tuition is provided by the University.

IN view of the fact that a case of small-pox has been reported in each of two of our leading universities, it may be well to state that during the first week in April the United States Marine Hospital Service reports only one case of small-pox throughout all the middle and New England States. There is, however, a slight epidemic of small-pox at New Orleans.

THE University of Pennsylvania has made some changes in the regulations under which candidates are advanced to the higher degrees. Hereafter the theses for the doctorate must be printed and it is expected that in the case of longer theses the University will contribute $50 towards the cost. The examinations will be written and may be passed at such time as the candidate is prepared. Instead of appearing before the dean and a committee of three examiners for an oral examination as at present, the candidate will be presented to the entire Faculty of Philosophy in formal session, with the Provost in the chair. A representative of the Group Committee with whom the candidate has taken his major subject will spread before the Faculty the candidate's credentials. These will comprise a brief sketch of his academic life, a more detailed account of the scope and character of his work as a graduate student, of the examinations which he has passed, and more particularly of the scope and significance of his thesis. His presenter will then formally recommend him to the Faculty on behalf of the Group Committee as a candidate for

the degree of Doctor of Philosophy. After hearing the candidate's credentials read, any member of the Faculty may make further inquiries of the candidate or of the presenter; and a formal vote will then be taken upon the recommendation. The regulations for the Master's degree will differ from those above outlined only (1) in the amount of work required; (2) in the fact that the dean will act as presenter; (3) and that no reference will be made to a thesis.

It will be remembered that the doctors' theses in the German universities were written in Latin till about thirty years ago. Another step toward the abolition of Latin as the official language of the universities is now being taken as it is planned to use German in doctor's diplomas and other official documents.

The enrollment of students in the University of Kansas is now 1130. This number is divided among the various schools as follows: Arts, 546; Engineering, 165; Law, 162; Pharmacy, 85; Medicine, 33; Fine Arts, 91; Graduate School, 48.

The position of Demonstrator of Histology and Embryology at the Harvard Medical School is vacant. The salary for the ensuing year will be not less than $750. The holder of this position is expected to be generally responsible for the laboratory class work, which will require about half his time throughout the year. The remainder of his time is to be given to original research. Applications should be accompained by a statement of previous experience in teaching and investigation, and may be addressed to Professor Charles S. Minot, Harvard Medical School, Boston, Mass.

Dr. E. Benjamin Andrews, superintendent of the public schools of Chicago, has declined the chancellorship of the University of Nebraska.

Dr. C. M. Bakewell, of Bryn Mawr College, has been called to a professorship of philosophy in the University of California and will be succeeded at Bryn Mawr by Dr. David Irons, of Cornell University, who will have the title of 'Associate.'

Dr. W. E. Castle has been appointed instructor of zoology in Harvard University.

The following promotions and new appointments have been made at the University of Chicago:

L. W. Jones, Assistant, to an Associateship in Chemistry.

H. G. Gale, Assistant, to an Associateship in Physics.

Stuart Weller, Associate, to an Instructorship in Geology.

F. R. Moulton, Associate, to an Instructorship in Astronomy.

H. E. Slaught, Instructor, to an Assistant Professorship in Collegiate Mathematics.

Ella F. Young, Associate Professorial Lecturer, to an Associate Professorship in Pedagogy.

E. O. Jordan, Assistant Professor, to an Associate Professorship in Bacteriology.

W. I. Thomas, Assistant Professor, to an Associate Professorship in Sociology.

George E. Vincent, Assistant Professor, to an Associate Professorship in Sociology.

James H. Tufts, Associate Professor, to a Professorship in Philosophy.

Jacques Loeb, Associate Professor, to a Professorship in Physiology.

S. W. Straton, Associate Professor, to a Professorship in Physics.

John E. Webb, Graduate Student, to an Academy Assistantship in Physiography and Biology.

Howard Emlyn Davies, Fellow, to an Assistantship in Bacteriology.

George W. Ritchie, to the Superintendency of Instrument Construction at the Yerkes Observatory.

W. F. E. Gurley, to an Associate Curatorship in Paleontology.

Frank R. Lillie, Professor of Zoology in Vassar College, to an Assistant Professorship in Zoology.

Leonard E. Dickson, Associate Professor of Mathematics in the University of Texas, to an Assistant Professorship in Mathematics.

Alexander Smith, Associate Professor of Chemistry. to a Deanship in the Junior Colleges.

C. R. Barnes, Professor of Botany, to a Deanship in the Colleges.

Llewellys F. Barker, M.D., Professor of Anatomy in the Johns Hopkins University, to a Professorship in Anatomy and the Headship of the Department.

Dr. Gattermann, of the University of Freiburg, i. B., has been promoted to a full professorship, and has been made director of the Chemical Institute.

Mr. W. B. Hardy, of Gonville and Caius College, Cambridge University, has been appointed senior demonstrator in physiology.